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WILDLIFE GUIDELINES FOR RANGE FIRE REHABILITATION

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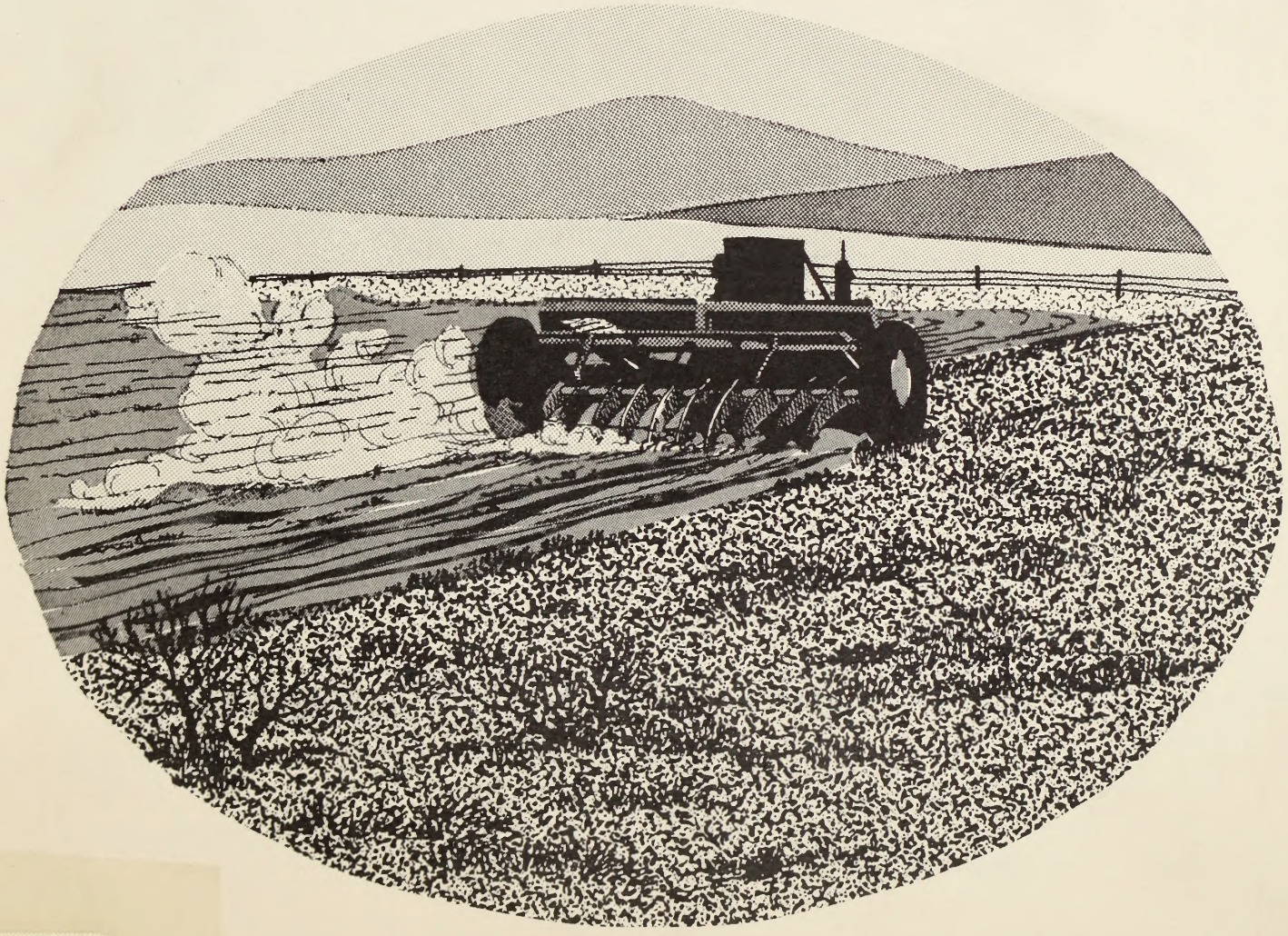

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Artificial Revegetation

WILDLIFE GUIDELINES FOR RANGE FIRE REHABILITATION

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WILDLIFE GUIDELINES FOR RANGE FIRE REHABILITATION

A. Application. These guidelines apply primarily to southern Idaho but are applicable to similar sites in the specified vegetation types.

B. Vegetation Types. The major zone of range fires considered here is in the northern desert shrub or sagebrush-bunchgrass (Artemisia tridentata - Stipa thurberiana) type originally present on the Snake River Plain and other ecologically similar plains and broad valleys of this region. In general, soils are of sedimentary and windblown material varying in texture from sandy to silty loams. Precipitation is deficient at all seasons with an annual average of 8 to 12 inches mostly falling in the winter. Plants grow rapidly in the spring, are largely dormant during the summer, and are reactivated by fall rains. Historically, these lands were used for spring-fall sheep range. Repeated burning and excessive grazing have reduced the climax vegetation to seral stages. Vast areas of sagebrush remain with cheatgrass the prominent understory. Repeated fires have largely eliminated sagebrush over extensive areas. These burns support cheatgrass and a variety of annual weeds. Needle and thread grass has replaced much of the Thurber's needlegrass and is associated with Sandberg bluegrass and squirreltail which in turn may dominate on disturbed sites. Rabbitbrush is a common invader, especially on sandy soils. (Davis 1952, Murray 1971, Wright and Klemmedson 1965) More favorably situated, at successively higher elevations, the juniper-pinyon, mountain mahogany or mountain brush, and the ponderosa pine types, also considered here, have a better potential for successful rehabilitation. (Plummer, Christensen and Monsen 1968)

C. Response of Vegetation to Fire.

1. General. Blaisdell (1953) found that burning causes damage to plants by both heat of the fire and removal of aerial parts of plants. Early in the first growing season after burning, perennial grasses and forbs are low in vigor--rhizomatous species less than others. Shrubs consist of only a few sprouts. Much bare ground is exposed, but it is soon occupied by annuals. Vigor improves later in the season but few flower stalks are produced. Perennial grasses and forbs remain green about two weeks longer than on unburned areas. Production of most species is low. Vigor improves during the second year and most grasses and forbs produce an abundance of flower stalks. Their maximum production may be reached the third year and thereafter be maintained indefinitely or decline. Shrub production may continue to increase.

Blaisdell (1953) re-examined two planned burns in southern Idaho after 12 and 15 years. All grasses were injured by burning; however, most had recovered their pre-burn productivity. Bluebunch wheatgrass recovered rapidly, but Idaho fescue and needle and thread were still less productive. No perennial forbs were permanently damaged and many benefited and were more productive after burning. In general, herbage production of shrubs was still significantly lower on the burned area due principally to loss of sagebrush. After 15 years the number of sagebrush and bitterbrush plants was about half that of unburned range. Rhizomatous or sprouting species of any category quickly recovered, while plants depending on seed were severely handicapped.

Mueggler and Blaisdell (1958) at Dubois (Forest Service research station) studied the effects of a hot, August burn in sagebrush-bunchgrass over a three-year period. There was no grazing through the second year following the fire. Big sagebrush and bitterbrush were destroyed. After three years, new sagebrush plants were becoming re-established. Idaho fescue production was approximately one-third that of the control. Overall, burning produced sizable increases in available forage. Three years after treatment the total production of desirable and moderately desirable species was approximately two-thirds greater than on the untreated range.

2. Perennial Grasses. Burning tends to deplete a stand of its perennial grasses and to allow annuals, chiefly Bromus tectorum, to increase sharply. These effects may be long lasting, about 25 years on some areas protected from grazing (Pickford 1932), on others the effects have been temporary. Early burning especially reduces plant vigor. Pechanec, Stewart and Blaisdell (1954) found that the productivity of perennial grasses the year following an early burn was less than one-third of normal. Late summer or early fall burns were considered less damaging. If the burn comes after seed is disseminated and when leaves are drying rapidly, reduction in vigor of grasses will be held to 30 to 40 percent the following year. Wright and Klemmedson (1965) cite Tisdale's observations in southern Idaho on three accidental burns where Poa secunda, Sitanion hystrix, and Stipa thurberiana were severely damaged. Wright and Klemmedson (1965) reported on the experimental burning of individual plants of four species on sagebrush-grass range in southern Idaho. They were: Stipa thurberiana, Stipa comata, Sitanion hystrix, and Poa secunda. Two burning temperatures were applied, one was approximately 200F or about the temperature at the soil surface during a grass fire (as cheatgrass), and the other 400F or about the temperature of brush fires (as sagebrush). Experiments were repeated in each of three summer months. Fires of equal intensity were more damaging on hot days than on cool days. Poa secunda showed no change in basal area at any month burned for either large or small clumps. Sitanion hystrix had a reduction in basal area from burning in July, but no plants were killed. June burning killed most of the

Stipa comata plants, few died following July burning, none died in August. Basal area was severely reduced following burning. Burning during the seed-formation stage may be more serious than later burning when plants have built up their carbohydrate reserves. Forty percent of the large plants of Stipa thurberiana burned at 400F in June died; others were unaffected. Basal area reduction was significant for all treatments in June, and also for large plants in July and August. Stipa species were damaged more seriously than Sitanion hystrix. Unlike Sitanion, Stipa crowns often showed sub-surface charring. The root-shoot transition zone of these species is about 4 cm. below the soil surface. Flower stalk production was much reduced the year after burning.

Conrad and Poulton (1966) recorded effects of a July wildfire in northeastern Oregon on an 80-acre exclosure protected from grazing for 20 years. The adverse effect on Idaho fescue was complete mortality or reduction of basal diameter of plants left alive. The effect on bluebunch wheatgrass was primarily limited to a reduction of basal diameter. A basic difference in these two plants is that Idaho fescue is characterized by a compact root crown area where the budding zone is confined to a relatively small area at or above the ground surface while bluebunch wheatgrass is less compact and buds are produced below ground level. Damage to both species was greater on ungrazed (more abundant fuel) areas than on grazed (outside) range.

3. Shrubs. Wright (1972) reviews a number of studies and discusses shrub response to fire in various plant communities, as further summarized below. Sprouting shrubs as a group are relatively fire tolerant. Most shrubs that depend upon seed for reproduction produce numerous seedlings following fire, but if fires are too frequent many of these species may be removed completely (as big sagebrush). Almost all berry plants (as Rubus) are fire resistant and are rejuvenated by fire apparently due to an adaptation of accumulating large quantities of nitrates in their tissues.

Northern desert grass-shrub. Even when they are not prevalent, fires can have a devastating and long-lasting effect on shrubs in sagebrush-grass communities. Big sagebrush, a non-sprouter, is highly susceptible to fire. Blaisdell (1953) found that the production of big sagebrush on burned areas in Idaho was only ten percent of that on the control 12 years after the burn. However, at the Dubois Station some areas recovered more quickly. Artemisia tripartita is damaged by fire but some plants resprout. In Idaho 12 to 15 years after a burn, antelope bitterbrush was still only producing 50-60 percent as much as the control. Some bitterbrush plants resprout following a burn if soil moisture is adequate. Resprouting plants may attain their original growth in 9 or 10 years. Desert bitterbrush resprouts regularly. Other species severely damaged by fire include serviceberry. Mountain snowberry may be damaged but gradually recovers. Rabbitbrushes are

enhanced by fire. Generally production is reduced for one to three years after burning, then it increases dramatically. At Dubois, burning reduced production 59 percent the first year, it doubled the third year and had tripled after 12 years. Fire greatly enhances production of horsebrush and favors Oregon grape. (Blaisdell 1953)

Southern desert grass-shrub. Although outside of the area treated here, it is of interest to note that Ephedra, Haplopappus, Guterierrezia, and Opuntia are destroyed by fire, whereas (in New Mexico) fourwing saltbush, winterfat, and skunkbush sumac resprouted vigorously after fire (Dwyer and Pieper 1967).

Oak brush. Gambel oak is a very fire-tolerant species; suckering is stimulated and growth is rapid. Chokecherry cover may exceed that of adjacent unburned areas in two years. Ninebark and snowberry (S. vaccinoides) received only slight, temporary damage from fire. Serviceberry recovered rapidly. (McKell 1950)

Juniper. Non-sprouting species susceptible to fire include J. monosperma, J. osteosperma, J. occidentalis and J. scopulorum. Small trees are most easily killed. Numerous seedlings often follow burning of old trees. Fire is a major factor in controlling the distribution of juniper.

Ponderosa pine. Many shrubs resprout vigorously including: ninebark, oceanspray, bitter cherry, willow, syringa, serviceberry, rose and spiraea. Bitterbrush is severely reduced by fire; one stand was still not fully recovered 27 years after a wildfire in Central Oregon. (Weaver 1967)

The effect of fire on shrubs should always be evaluated in relation to age of plants, soil moisture at time of burn; intensity of the fire, season of burn, health of herbaceous plants, and the frequency of droughts. All of these factors can, and usually do, affect the response of plants to fire. (Wright 1972)

See Appendix 1, Shrub Response to Fire, for list of sprouting and non-sprouting shrubs.

D. General Recommendations.

1. Pre-plan and be prepared for emergency post-burn action.

a. Develop standard operating procedures, including cooperative action with other agencies.

b. Maintain an inventory of available equipment and pre-arrange for its use.

c. Maintain in storage, a reasonable supply of the most-needed seed varieties that are not readily available. (See Appendix 4).

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2. Preliminary action to take following a burn.

a. Consult wildlife inventory and analysis data and URA wildlife overlays to note:

(1) importance of burned area as habitat,

(2) principal wildlife species, and

(3) recognized opportunities for development.

b. Review MFP land use decisions for the site, especially regarding wildlife habitat.

c. Consult the wildlife habitat management plan covering the burned area for guidance.

d. Coordinate with other staffs, as appropriate, to plan cooperatively.

3. Cooperatively conduct an on-site post-burn analysis of the situation with specialists in the various affected resources. Consult with the state wildlife agency.

4. District wildlife specialists should actively participate in making post-burn analyses and staff recommendations, and in planning and carrying out rehabilitation.

5. The first decision based on the analysis is whether any developmental action is needed for wildlife. Natural recovery with management is preferred.

6. Endeavor to restore a natural situation when planning and conducting necessary rehabilitation. Avoid extensive monocultures.

7. Preserve unburned islands, irregular unburned peripheral areas inside fences, etc., if good habitat.

8. Use management plans and decisions to guide development.

9. Management of burns requires special measures for extra-conservative use during the re-establishment period. A multi-discipline supplemental management plan should be promptly implemented.

10. Make periodic evaluations to observe the success of rehabilitation and the effect of management. Initiate studies if needed to objectively document these results or to test new techniques or procedures.

E. Is Any Action Necessary? Natural recovery of a burned area is the most desirable alternative. If analysis of a burn indicates that desirable species will recover rapidly without important interim losses, or degradation as through plant invasion, then nothing more than site protection from destructive use may be needed. (Appendix 2, Checklist)

Protection may require fence construction, temporary non-use by livestock and/or reduced use by big game animals (via cooperation of the state game agency). Management alone may be adequate, or management plus project work may be needed.

The severity of the burn obviously is an important factor. Depending upon the species, lightly burned perennial plants with uninjured crowns or underground stems, or shrubs which sprout following crown injury can be expected to recover quickly. Fire removes plant competition and conditions seed of some sorts to germinate. Many weed species are in the latter category.

Erosion potential. In addition to the loss of vegetation consider slope and exposure, soil texture and structure, and special characteristics. Consider both wind and water erosion.

Priority values for various wildlife species should have been previously recorded in available URA and wildlife inventories. Map overlays on file in district offices delineate important wildlife habitat by species or groups. Include consideration of non-game species.

Special consideration needed for wildlife might include the need for replacement of shrub cover, or replacement of stream-bank cover, with or without fencing, for fisheries habitat protection.

Consider site potential for recovery without projects. Determinations will be based on:

- Degree of vegetation destruction (further guides needed)
- Kinds of residual seeds, etc., on site or likely to invade
- Erosion potential
- Sufficient soil depth
- Sufficient precipitation

Natural recovery expectancy is satisfactory if site potential is high.

Some development, such as protective fencing, may be needed even if satisfactory natural recovery is expected.

If natural recovery is doubtful and project work is needed, the question is: Can practical treatment be recommended for the site? To make this decision it is necessary to know: (1) the habitat requirements of the wildlife species present, and (2) the plants available for meeting the habitat needs, and their site requirements and propagation.

F. Wildlife Habitat Requirements. Brief summaries of habitat requirements of selected wildlife species emphasizing information pertinent to the subject of range fire rehabilitation are presented in Appendix 7. The source material, except for the most general information, is cited either here or in the lists of references included in Bureau Manual Technical Supplements 6601 for the species covered. Many additional species should be included here, especially non-game wildlife. Appendix 6, Plant-Animal Relationships, lists some game and non-game wildlife known to utilize the listed plants. See Appendix 8 for selected game bird nesting data.

G. Plants for Habitat Rehabilitation. The following information briefly describing some of the plants useful in range rehabilitation for wildlife came from many sources. The most generally useful reference for this area is Restoring Big Game Range in Utah by Plummer, Christensen and Monsen. It is based on more than 15 years of original research about adapted plants and their propagation. Grasses, forbs, shrubs and trees are all important to wildlife as shown in the previous section on wildlife habitat requirements. Mixtures that include each of these plant groups, as in the natural composition of vegetation, are normally recommended for seedings to restore habitats. These three types of plants are often utilized at different seasons and for different purposes by the various wildlife species. Good ground cover is produced more quickly with grass in the mixture, however because shrubs mature more slowly the factor of competition must be considered. Appendix 3, Seed mixtures for the big sagebrush type, (from Table 5 in Plummer et al 1968) lists two recommended mixtures for game ranges on dry, low elevation sites.

1. Grasses. Grasses are an especially important segment of the vegetation. Their seeds are valuable to birds and small mammals, their leaves and stems are used by rabbits, deer, and other herbivores, and in addition the plants provide protective cover to many small and medium-sized animals. (Martin, Zim and Nelson, p. 368, 1951). The particular species of grass appears to be less important to the animal than the general requirements of rank growth for cover, or early tender green feed for forage.

A limited number of grass species are adapted to the 8-10 inch precipitation zone. Plummer et al (1955) suggest crested wheatgrass. Russian wildrye, Indian ricegrass, bottlebrush squirreltail and sand dropseed for these dry, lowland ranges. With more than 12 inches of rainfall, there is a relatively good selection of adapted species.

Because descriptions of grasses and their growth requirements are more generally available and grass seeding is a common practice as compared to forb and shrub seeding, individual species are not discussed in the following brief treatment of selected plants for habitat restoration. For one example, see Plummer et al 1955.

2. Forbs. As a whole, annuals with their large seed crops are more valuable than perennials to seed-eating wildlife, especially ground feeding birds and small mammals. (Martin, Zim and Nelson, p. 368, 1951). Many of the preferred species (as ragweed, knotweed, tarweed) are common weeds that volunteer readily on disturbed soils. Forbs recommended for use in seedings may be commercially available as alfalfa and clover, or are wild, perennial plants, as balsamroot. Improved strains of wild plants could be developed in time, and seed availability increased by establishing field plantings. Forbs seeded with grasses should be compatible and able to persist in the stand.

3. Shrubs. Besides providing essential cover and nesting habitat for many wildlife species, the fruits, seeds, and foliage of woody plants also furnish a large share of their food (Martin, Zim and Nelson, p. 287, 1951). The value of browse to big game animals, especially in the critical winter season, is well known.

There is a growing recognition of the excellent possibilities for developing improved and adapted shrub strains through breeding. Some shrubs hybridize in nature between species and subspecies and their ecotypes. Occasionally inter-generic crosses occur, as between bitterbrush and cliffrose. Large differences exist between ecotypes in growth requirements and characteristics, productivity, and palatability. New and better shrubs can be developed and a higher quality of seed produced by selection and hybridization. Research is underway. (Van Epps, Plummer, and McKell 1971)

Medicago sativa

Alfalfa

Description. An introduced, herbaceous, perennial legume of many varieties having special characteristics, including some rhizomatous forms. Retains succulence later than grasses. Begins growth early and makes excellent regrowth when soil moisture is available. Stems are erect and reach several feet in height. Taproot extends up to 30 feet in permeable soil.

Distribution. On rangelands, it is found on the better lowland sites and in the mountain brush zone (Utah).

Site Requirements. Best production is on well-drained, deep loam soil with open, porous subsoil. Avoid soils with impervious subsoil, hardpan or bedrock near surface; avoid soils with water table near surface; and avoid strongly saline or alkaline soils. Alfalfa requires about neutral or moderately calcareous pH reaction. It is grown from below sea level to 8000 feet elevation. It withstands hot weather. Cold hardy varieties are required in the north. Frost heaving may occur on poorly-drained clay soils. The minimum precipitation level is around 12 inches on soils with good moisture-holding capacity, and 14 inches on less favorable sites. Some of the newer drought-resistant grazing types have succeeded where precipitation exceeds 9 inches. In Utah, seedling stands were good at 8-10 inches of precipitation but later were destroyed by rabbits and drought.

Utilization. Alfalfa is one of the most palatable and nutritious forage crops in the U.S. Besides its well-known value for livestock, the foliage and seed pods are taken by various birds and mammals. Antelope, deer, elk and other large grazing animals find alfalfa very attractive. Small mammals including the jackrabbit, marmot, prairie dog, various ground squirrels, pocket gopher, kangaroo rat and mice sometimes make destructive use of the plant. Birds utilizing the leaves, flowers or seeds include sage grouse, sharptail grouse, pheasant, valley quail, Hungarian partridge, baldpate, mallard, little brown crane, and others.

Propagation. Use of local, certified seed is advisable. Plump, bright olive-green seed is viable. Seed should be inoculated if used on new ground. Sow half-inch deep on heavy soil, deeper on dry, sandy soils. Alfalfa requires a firm seedbed. Spring seeding usually is best; late fall seeding may be satisfactory if fall germination is avoided. Broadcasting has been more successful than drilling on Utah game ranges (Plummer, et al 1968). Aerial seeding followed by chaining is satisfactory. Rodents can be a problem on new seedings. Root cuttings from spreading types may be transplanted.

Rangeland Strains. Ladak, a non-spreading type, is widely used in the West for hay and dryland pasture. It is well-adapted to rangelands, it is winter hardy and withstands summer drought. Seed is readily available; it may be mixed with rhizomatous strains. Ladak has grown as well as Nomad at Ephraim. Nomad is a spreading, rhizomatous form well adapted to range seeding. Its extensive root system and underground stems provide additional survival values. In extensive trials in eastern Oregon, Nomad was the best dryland grazing variety tested (1961 Report On Dryland Grazing Alfalfas by Crops Research Lab., ARS, Logan). Rodents (gophers, mice) were destructive but Nomad was least affected. It withstood heavy grazing and adverse weather conditions. The presence of grass generally suppressed yields. On one site in Morrow County (350 ft. elevation, 9 inches precipitation, sandy soil) sagebrush was burned and 1 pound of alfalfa and 8 pounds of grass per acre were aerially seeded; and, 6 years later the stand was still excellent. Another example, in Grant County (2700 ft. elevation, 8 inches precipitation, heavy clay loam) Nomad was the only variety standing up under year-long deer use plus a May-July season for cattle grazing. In early trials in Utah with 20 alfalfa strains, after 6 years, Nomad produced top yields. Other recently developed creeping forms of alfalfa, similarly well adapated, include: Rambler, Rhizoma, Teton and Travois.

Astragalus cicer

Chickpea milkvetch

Description. Perennial, persistent, long-lived forb from Siberia. Winter hardy, vigorous, sod-forming legume, large-seeded. Largervolume of top growth than native milkvetches.

Distribution. Adapted to the better lowland sites and mountain rangelands. More widely adapted than sicklepod. Similar to alfalfa in area of adaptation.

Site Requirements. Slightly shade tolerant; more frost tolerant than alfalfa, more productive and competitive, more resistant to gophers, insects and diseases, and is longer-lived. It begins growth later and is about equal to alfalfa in drought and salt tolerance and better adapted to shallow or moist soils. More persistent than alfalfa on subirrigated soils. Nearly neutral soils are best, especially those derived from limestone. Precipitation minimum around 12-14 in. (Hafenrichter et al, 1968).

Utilization. Chickpea forage is very palatable at all stages to all classes of livestock. Palatable to deer and elk. It recovers rapidly from grazing and remains green through the summer. Season of use is similar to alfalfa. It is remarkably free of diseases and insects. Milkvetches (Astragalus spp.) produce hard seeds which are eaten by quail and other game birds; marmot, pocket mouse and other rodents, and some big game use including antelope and bighorn sheep.

Propagation. Seed pods hold well and do not split open. May have 50 to 75 percent hard seed. Germination has increased with length of storage (dry, cool), the percentage of hard seed decreasing through a 14-year test period (Hafenrichter et al, 1965). Seeds should be scarified to remedy the effect of hard seed. A desirable pure live seed requirement is 65 percent. Drill 4 lbs./acre in 12-inch rows or 6 lbs. in 6-inch rows. Chickpea can be seeded with an adapted grass or other legumes in alternate rows. Don't mix seeds in same drill row and don't broadcast. Spring seeding gives best results. A firm, moist, weed-free bed is essential. Seedling emergence is slow; they are of low vigor and are poor competitors. Rhizomes start forming in the second year when sodding begins. Restrict grazing until plants come into full production - usually two or more years. Delay spring grazing on established seedings until plants are at least 6 inches high. Old stands are persistent and eventually crowd out other species. Chickpea propagates vegetatively as well as by seed.

Moderate treatment in sulfuric acid approximately doubled germination of both chickpea and sicklepod seeds over the controls when followed by 4 months of cold stratification (Plummer et al 1970).

Related Species. Astragalus falcatus (sicklepod) is a large introduced, taprooted legume adapted to the more favorable sunny sites in mountain brush, pinyon-juniper and big sagebrush types. The good production of palatable forage is utilized by big game in summer and may be available above the snow in winter. Lack of a good seed source currently limits use. (Plummer et al, 1968) Can be used in mixture with crested wheatgrass. The tough seed pods should be run through a hammer mill at low speed.

Balsamorhiza sagittata

Arrowleaf balsamroot

Description. A large, native, perennial forb one to two feet in height. Large taproot and strong, deep root system. Long lived. Fruit is an achene; the seed crop is usually good.

Distribution. Abundant on favorable sites and sometimes growing in large stands, balsamroot is adapted to plains and valleys, foothills and low mountain ranges. It occurs on open slopes and ridges throughout the sagebrush, oak brush and ponderosa pine types and above. Balsamroot is found on the Snake River Valley bunchgrass prairie in Idaho associated with filaree, lupine, yarrow, **astragalus** and other forbs. (Davis 1952)

Site Requirements. Found on well-drained soils in open, fairly dry situations, including south slopes. It is often important in Idaho on harsh sagebrush sites receiving at least 9 inches precipitation.

Utilization. Balsamroot begins growth early and is utilized on spring ranges. Rated as fair forage for all classes of livestock. Flowers are especially palatable. Game animals and sheep may eat the seedheads before seed ripens. Deer and elk use both leaves and flowers before plants turn dry.

Propagation. Seed is collected by hand. It can be seeded successfully and can be grown with grass or alfalfa. It requires several years to attain much size. Germination following cold stratification was much superior to fluctuating temperatures approximating room or natural conditions: 19-78 vs 0-2 percent respectively for four sources of seed. Seed collected in 1963 had 40 percent germination in 1965 and 26 percent in 1967. (Plummer et al 1970)

Related Forms. Natural hybrids of Balsamorhiza species are known (Plummer et al 1968).

Melilotus officinalis

Sweetclover

Description. An introduced, tall, taprooted biennial legume. Plants may grow one to three feet the first year and produce strong, new growth from dormant buds on the root crown the next season. The second year plants may reach 4 to 5 feet or, on choice sites, they may be twice that tall. Plants bloom and die at the end of the second season. Sweetclover is a rapid-growing, deep rooted plant with high nitrogen fixation. The yellow blossom variety is preferred for our purposes because of its wider adaptability; it also has finer stems and shorter growth than white-blossom sweetclover.

Distribution. Sweetclover grows almost anywhere that moisture is sufficient. Sometimes referred to as a common weed, it invades disturbed sites, roadside ditches and waste places. It grows well on the better lowland sites, in the mountain brush and pinyon-juniper zones, and on moderately salty moist areas. Often seeded on cultivated land for soil building or pasture improvement.

Site Requirements. Sweetclover requires calcareous soils. It will withstand more alkali than most crops. It is very resistant to cold, drought and heat. Yellow blossom produces better than the white-flowered variety on dry, sandy soils. The improved Madrid strain is more drought resistant than common yellow-blossom and has better resistance to frost during fall of its first year. The minimum precipitation requirement for range seeding appears to be around 12 inches; however, 16 inches of rainfall is more commonly recommended for most purposes.

Utilization. Sweetclover is widely used for soil improvement due to its large yield of organic matter and its ability to add nitrogen to the soil - a good crop may add 100 lbs. nitrogen per acre. It is recommended for seeding in mixtures on exposed soil. It provides a high protein, palatable forage to cattle, sheep and horses. The plant survives heavy use, and matures seed even under moderate use. Sweetclover produces considerable forage for deer, elk and antelope. Also, use by pheasants, valley quail, sharptailed grouse, Hungarian partridge, cottontail rabbits and ground squirrels has been recorded. The seeds are of moderate value to some upland game birds.

Propagation. Sweetclover is recommended for use in reseeding burned grazing lands. Normally, it reseeds itself on the more favorable lowland sites, as it builds up a supply of seed in the soil. The hard seed lies dormant until conditions of temperature and moisture are favorable. (Seeds of the yellow-blossom variety may be distinguished by their dark greenish-yellow color with flecks of purple.) Seed should be scarified or fall sown.

Seed should be inoculated using the same inoculant as for alfalfa. A firm seedbed is necessary. Drill in spring on fallow soil. Seed can be broadcast in late fall, preferably covering the seed with a harrow. Mountain brome and slender wheatgrass can be seeded with sweetclover on sites receiving 16 inches or more precipitation. Use in mixture with tall wheatgrass on moderately alkaline areas. The Madrid variety is preferred for its better early seedling vigor.

Onobrychis viciaefolia

Sainfoin

Description. A tall (2-3 feet), leafy, herbaceous, perennial legume introduced from Russia and Turkey. Used for hay and pasture in Europe (French: sain foin = wholesome hay). It generally is long lived. Seeds are about the size of small peas. Good seed production.

Distribution. Sainfoin is adapted to rangeland with 12 or more inches of precipitation and elevations over 2500 feet. Compatible in mixtures with bunch grasses. (Hafenrichter et al 1968)

Site Requirements. Adapted to a wide variety of soils, sainfoin's optimum requirement is similar to alfalfa. It does not grow well on poorly drained land or bottomland with a high water table. It was the most drought and frost tolerant legume tested at Aberdeen SCS Center in southern Idaho; it recovers early both spring and fall. It is resistant to winter kill.

Utilization. Sainfoin is palatable to livestock and big game. In southeastern Idaho it was used by deer in the early spring. The protein content of seeds has been recorded at 35 percent.

Propagation. Seeds germinate quickly even on the surface of moist soil. Broadcasting, however, is not recommended. There is no known effective inoculant. A firm, moist, weed-free seed bed is required. Spring seeding is preferred. Unhulled seed is easily drilled with a standard grain drill. Use 6-8 pounds of seed per acre if mixed with grass at 18-inch row spacing.

Sainfoin starts spring growth about the same time as crested wheatgrass. It has produced better than alfalfa on dryland, especially if precipitation is greater than 12 inches. Intermediate wheatgrass can be sown with sainfoin. A mixture of sainfoin and Russian wildrye was superior to other sainfoin-grass mixtures on dryland in Alberta. At Squaw Butte station in southeastern Oregon, sainfoin became established when drilled into existing stands of crested wheatgrass. Sainfoin has performed poorly in mixtures with rhizomatous grasses, but also has been reported to compete with sod-forming western and thickspike wheatgrasses. It shows some resistance to damage by gophers, insects and disease.

Related Forms. A selection 'Onar' has been released. It is adapted to the upper Snake River basin non-irrigated croplands under conditions of dry summers, short growing season, precipitation over 14 inches and elevations over 4000 feet. (Hafenrichter et al 1968) A strain 'Eski' developed in Montana is a large, 2-foot high plant reported to outyield grass.

Sanguisorba minor

Small Burnet

Description. A perennial forb of the rose family. Height 12-18 inches. Stays green late into summer. Rapid growth. Deep rooted, taproot. Good seed production.

Distribution. Limited quantity raised commercially and used in pasture mixtures on poorer soils. Commonly used on dry California ranges, and at times in southwestern Oregon on dry, logged and burned areas at 1000 to 2000 feet elevation. Seeded south of Ephraim, Utah, at 6000 ft. elevation and 13-inch precipitation zone, it did not persist in the mixed stand.

Site Requirements. Burnet grows on poor, low fertility land with well-drained soil. It is drought resistant, but minimum precipitation is given as 18 to 20 inches.

Utilization. Burnet is very palatable and is preferred forage for sheep and deer. Yields are low but protein and carotin content is high. Rodents have not been much of a problem with the forage.

Propagation. Seed is usually obtained commercially. Rodents harvest much of the seed. Stands are easy to establish. Normally mixed with grass to improve yields. Germination of 90-95 percent has occurred under natural conditions. Germination percent of 1963 seed increased in 1967 over 1965 in tests of storage durability (Plummer et al 1970).

Amelanchier alnifolia

Common Serviceberry

Description. Large, native, deciduous shrub. Height may be 10 to 15 feet on favorable sites. Fruit edible, several-seeded, bluish berry-like pome, ripens July-September. Deep, spreading root system.

Distribution. Very widespread. Usually grows in mixtures with other shrubs. It is probably most common in the upper limits of the ponderosa pine type; also found in mountain brush and the upper pinyon-juniper types. Frequently associated with aspen, chokecherry, maples and Gambel oak.

Site Requirements. It grows under a great variety of environmental conditions. It is found on dry, rocky slopes in full sunlight, or in the partial shade of coniferous timber; it also occurs on moist, deep and fertile soils.

Utilization. A very important forage species. Browse is used year-long by livestock and deer. Provides fairly good forage for cattle and good for sheep. Usually browsed after midsummer, but on browse ranges it is one of the first species grazed. Subjected to heavy winter use in some areas. Withstands close grazing. Browsed by deer and elk. Fruits eaten by many birds and rodents (including grouse, quail, chipmunks) and bears.

Propagation. Hand harvest fruits in good years, collecting promptly before it is taken by wildlife. Dry before storage. Fresh fruits may be macerated in water to free the seeds. The yield is about 2 pounds of seeds per 100 pounds of fruit. Stratify seeds up to 6 months (or as necessary) to overcome embryo dormancy if spring planting. Nursery transplant seedlings may be used. This species has possibilities for improvement through selection. Plants sprout following fire.

Related Forms. Davis lists two varieties which some authors classify as species. A. alnifolia utahensis. The most common form in the Great Basin. Found on dry plains and hills in Idaho. There are both low and high forms with heights up to 16 feet. Grows on dry, well-drained, sunny sites. Utah serviceberry is used moderately by cattle in early spring. Good to excellent for sheep and goats. Browsed by deer.

A. alnifolia oreophila, mountain serviceberry, is a low bush, height to 6 feet, that grows in clumps. Found on dry plains and hills, in browse and woodland types. Usually growing in rather loose and dry, sandy, gravelly, or rocky soils. Locally abundant. Fruit ripens in September-October. It provides fair forage for sheep; poor for cattle.

Artemisia tridentata

Big Sagebrush

Description. Native. Large, erect evergreen shrub. Commonly 2 to 6 feet tall, or taller on deep, sandy, well-drained soils. Roots are both shallow-fibrous and deep spreading. Fruit, an achene, ripens in October or November. Non-sprouting.

Distribution. Widespread and abundant. Major plant constituent in the cover over vast semi-arid ranges. Abundant on valley bottoms, plains, foothills of the semi-desert lands. Invaded large areas of former grassland, especially in Idaho, Oregon, Nevada and Utah.

Site Requirements. Dry, well-drained, sunny sites. Grows on a variety of soils from the shallow rocky loams of foothills and slopes to the vast areas of disintegrated lava in the Snake River plains of Idaho. Seldom abundant on soils of granitic origin. It inhabits the rich limestone soils of valleys and foothills. Grows typically with wheatgrasses, bluegrasses, rabbitbrushes and snakeweed on the deep, well-drained alluvial clay loams at the foot of the main mountain slopes. In the open ponderosa pine, oak brush, and pinyon-juniper belts, it is found with wheatgrasses, snowberries, rabbitbrush, serviceberry, and needlegrasses. Grows best on rather light, pervious, well-drained, alkali-free soils having a good water supply. The deep root system can utilize water at considerable depths. Plants are frequently killed by flooding or the water table rising above the subsoil level. In general, it occurs within a 6 to 16-inch precipitation range.

Utilization. Low palatability but important due to abundance and high nutritive content (especially fats). Sheep often winter well on such areas. Rated poor for cattle or horses. Important winter deer food but unless mixed with other forage, the amount eaten is limited to less than one pound per day. Sagegrouse are dependent upon sagebrush year-round for food and cover. Also used by sharptail grouse, quail, antelope, bighorn sheep, mule deer, jack rabbit, pygmy rabbit, sage chipmunk and others.

Propogation. Big sagebrush does not form root sprouts readily and is easily killed by burning. Numerous seeds of high viability are produced during September or later. Quality varies with season and site. Water is more important than wind in dissemination. Seed germinates as early as April. Shade aids seedling survival. Seed can germinate quickly (without dormant period, but there is no natural fall germination). In one study seed exposed to light and warm (70F) temperature germinated best. Following burns seed stored in the soil germinated. Germination was best where least litter was present. Without competition, seedling growth may be remarkably rapid for a year or two. With grass competition, the sagebrush root system seems to be superior, but generally the grass

shoot grows faster and may suppress the sagebrush. (Beetle 1960) Seedlings can be transplanted easily.

Related Forms. Artemisia tridentata crosses with A. nova, and intergrades with A. arbuscula.

A. tridentata vaseyana occupies extensive ranges principally east of the tridentata subspecies especially Wyoming, Colorado, Montana, and the western edge of Idaho. It is a low shrub up to 3 feet tall. Seeds ripen in October-November. It occupies a great variety of sites. Rather easily killed by waterspreading. This subspecies is the most palatable and useful variety for forage. It crosses with A. cana which also is reported to be more palatable than big sagebrush; it also sprouts readily and spreads by underground stems, particularly after burning (Beetle 1960). (Possibly this cross, or one developed from these parents, could produce a palatable, sprouting, widely-adapted sagebrush for use in range rehabilitation.)

Artemisia nova

Black Sagebrush

Description. A native, low evergreen shrub up to 12 inches tall. Non-sprouting. The fruit is an achene ripening in October.

Distribution. Widespread through the intermountain west, extending through Nevada into eastern California. It is sometimes abundant and is often intermingled with areas of big sagebrush. It also occurs in woodland types and extends above ponderosa pine forests.

Site Requirements. Black sagebrush inhabits dry, rocky hillsides and ridges with shallow soils. Its elevation range commonly is 5000-8000 feet. On level plains and foothills it generally occupies sandy or gravelly loams.

Utilization. This species provides good ground cover where few other species are adapted. Its forage value varies with area. Generally rated low for cattle, good for winter use by sheep and deer. Palatability sometimes rated higher than big sagebrush.

Propagation. This species establishes well from direct seeding and wild transplants.

Related Forms. *A. nova* sometimes bybridizes with other *Artemisias*. Its wide adaptation indicates a variety of strains and may indicate a good opportunity for development through selection. Light and dark green ("black") forms are recognized. Black sagebrush crosses naturally with *A. tridentata tridentata* and less commonly with *A. t. vaseyana*.

Atriplex canescens

Fourwing Saltbush

Description. Native, dioecious, evergreen shrub of several growth forms. Height ranges from less than 3 feet on desert or highly alkaline areas to 5 feet or more on better foothill ranges. Growth is rapid. The root system is deep and extensive. Plants are extremely drought resistant; cold hardy. Stems are brittle. Fruits are dry, one-celled, winged pods (utricles) formed in conspicuous clusters on current-year growth of female plants; they do not shatter upon ripening in fall (August - September). Plants may begin seed bearing at 2 to 4 years of age. Good seed crops occur almost annually.

Distribution. Widespread. Not infrequently, it is the dominant species over extensive areas. Found in dry, moderately saline sites in the plains, foothills and intermountain valleys of the sagebrush, desert grassland, pinyon-juniper, oak woodland and creosotebush types. Occasionally, it is found up to 8,000 feet in ponderosa pine openings in Utah. It is usually in mixed stands with other saltbush species, sagebrush, winterfat, rabbitbrush, etc. It frequently occurs on grass ranges. Fourwing is one of the most important arid-site shrubs in its region.

Site Requirements. Fourwing saltbush is adapted to a wide variety of calcareous soils from heavy clay to sandy. Grows best on sandy loam or loam soils that give a reaction for calcium carbonate. It is found on sand dunes, flood plains, gravelly washes, mesas, ridges and slopes. It may be found on harsh southerly exposures. Precipitation should be at least 7 inches and salt concentration less than one percent. The best natural seedbed is a fine alkaline, alluvial soil. Fourwing is not an indicator of alkaline sites, but it does occur there.

Utilization. This is preferred forage at all seasons, especially the leaves and fruit. The palatable seeds are devoured by wildlife and livestock. The abundant production of fourwing is utilized by livestock. Plants need summer protection to withstand reasonably heavy winter use. Deer use is mainly in winter. Forage is nutritious with relatively high protein and phosphorus levels year-round. Quail use bushes for cover and feeding.

Propagation. Saltbush is a preferred plant for range rehabilitation. Seed can be harvested in fall or winter by hand stripping fruits into a container. If much seed is to be gathered on an area, keep stock out until the harvest. Birds and rodents also relish the seeds. About half the seeds may contain embryos. Long storage may improve germination. Some seeds apparently undergo afterripening for up to ten months after collection. Seed viability can be maintained for years in ordinary dry storage. Dewinging the fruits in a hammermill is recommended to facilitate seeding and hasten germination. Treatments such as soaking

in water or chemicals, stratification or scarification give inconsistent results. In at least one test, heavy scarification sufficient to remove all attached wings and roughen the seed coat, increased total germination substantially. Both moderate and heavy scarification hastened the rate of germination (Nord and Whitacre, 1957). The optimum germination temperature ranges between 55 and 75F. Germination will occur at low temperatures. In some tests, germination has varied inversely with seed size. It also varies with seed source. Under nursery conditions, seedlings begin emerging within 6 to 10 days, and germination usually is complete within 20 days. However, germination is variable and sometimes straggles over one and two years after sowing. Green seed may germinate promptly. Fully ripened seed may germinate better after 12 to 18 months in dry storage. Emerging seedlings are highly susceptible to frost and damping-off fungus. Mice and rabbits destroy seedlings. Use local seed whenever possible. It is particularly important to use seed from areas where the climate is as severe as the planting site. Plant dewinged seed one-quarter inch deep. Where climate permits, winter planting is preferred (Utah). Winter or spring seeding is recommended mainly to avoid late frosts killing sprouted seed. Seed may be broadcast at 8-10 pounds per acre followed by single disking. Good stands have followed aerial seeding of mixtures. Use about one pound of fourwing seed per acre in mixtures, broadcast or drilled.

Initial establishment sometimes is difficult, especially where annual precipitation is less than 12 inches. Once established, plants develop rapidly and sometimes exceed one foot in height growth the first year. Natural reproduction is often abundant. Transplanting wild seedlings or nursery stock has been successful. Transplant trials of wild seedlings on good sites had 90 percent survival. Transplants should be about 6 inches high (16-20 weeks old). Early spring planting in moist soil is recommended. Green weight may nearly double from the first to second year on good sites and plants reach 2.5 feet in height.

Related Species. Fourwing readily hybridizes in nature with several other Atriplex species. Prospects are excellent for development of improved strains through selection and hybridization. A. confertifolia is common in alkaline valleys, sometimes in gumbo soils or with greasewood (Sarcobatus); it is apparently more resistant to alkali than fourwing. Although plants are spiny, the leaves and fruits provide valuable forage. A. nuttallii a salt tolerant, low sub-shrub, provides winter forage especially for sheep.

Ceanothus velutinus

Snowbrush

Description. A tall, evergreen, thicket-forming shrub. Form may vary from a low-spreading bush, 2 to 5 feet high, up to 12 feet high on favorable sites. It has a single large taproot and a deep, spreading root system with nitrogen-fixing root nodules. The dry capule fruits ripen in July-August. Fruits ripen quickly and open suddenly, shattering within a few days.

Distribution. In mountains, with wide elevational distribution from the pinyon-juniper belt up to the aspens. Usually grows in patches or extensive brush fields. It is especially quick to invade burned or logged areas.

Site Requirements. Found on dry, sunny sites. Pioneer invader on bare soil in mountains. Usually on more or less acid soil. It is found on all exposures, a wide variety of sites, and almost any well-drained soil. It provides excellent soil cover and is valuable for watershed protection.

Utilization. The general forage value is very slight; worthless for cattle and horses; sheep, goats and deer sometimes graze the blossoms slightly as well as the new shoots that appear following fire. Sheep sometimes browse this species in Idaho; however, this is a sign of overgrazed range condition. Fair browse for mule deer and mountain sheep. Deer like to bed in snowbrush. Elk appear to browse snowbrush only in winter, but deer consume the forage at any season if better feed is not present. Used by various birds including quail, mourning dove; and by chipmunk, pica and jack rabbit.

Propagation. Abundant seed production. Long-lived seeds are stimulated by heat. In nature abundant seedlings usually follow fire. Impermeable seed coats and perhaps dormant embryos make preplanting treatment advisable. Soak seeds in hot water (180F) for several hours then stratify 2 to 3 months before spring planting. Plants can be propagated from hardwood or softwood cuttings. Vigorous sprouts quickly arise from the root crowns of burned plants.

Cercocarpus ledifolius

Curlleaf Mountain Mahogany

Description. Small evergreen tree or tall shrub, usually 3 to 15 (up to 40) feet in height. Fruit is an achene with a long feathery style. Seed dispersal is mainly by wind in August-September.

Distribution. Native in dry interior or mountainous regions of the west. Occurs from the bunchgrass prairie, through the pinyon, woodland, ponderosa pine and higher zones. It may occur in association with oak, serviceberry, bitterbrush or gooseberry. It characteristically grows in isolated, pure patches of more or less frequent occurrence and is seldom found singly or in continuous, extensive stands. Stands may be open or rather dense.

Site Requirements. Found mainly on warm, dry, sunny, rocky ridges and chiefly on southern or fairly dry western slopes. At lower elevations in the Great Basin it often grows in coarse, gravelly and rocky soils on steep north slopes, cliffs or ledges. Curlleaf will thrive on sites too dry for most other shrubs. It sometimes occurs on clay or loam soils.

Utilization. Curlleaf usually has little or no palatability for domestic livestock in the summer, but may be browsed by cattle, sheep or goats from late fall to early spring where available. It is rated as outstanding winter forage for deer, and in some areas also for elk. In mature stands much of the foliage is out of reach; however it provides excellent winter shelter.

Propagation. Seed on well-drained soils in sunny locations. In one test, 22 pounds of cleaned seed were obtained from 100 pounds of fruit. Curlleaf germinates very slowly without pretreatment. Good seed crops are produced at irregular intervals. Seedlings are sensitive to frost and drought.

Related Form. A dwarf form (C. l. intricatus) is even better adapted to severe hot and dry sites. C. ledifolius x C. montanus hybrids occur naturally.

Cercocarpus montanus

True Mountain Mahogany

Description. This species is uncommon in Idaho. Ordinarily a bushy shrub 2 to 10 feet high, it is rarely a small tree up to 20 feet tall. It has a deep, spreading root system. The fruit, an achene, is available August to October. There usually is a good crop of seed.

Distribution. This species usually is sparsely distributed but in localized areas it may be an important constituent or even the dominant species of the association. It is frequently associated with Gambel oak, juniper, pinyon, ponderosa pine, serviceberry, bitterbrush, manzanita, ceanothus, sagebrush and rabbitbrush.

Site Requirements. It occupies well-drained, sunny sites, either in coarse sometimes poor shallow soil on dry slopes and rocky ridges or in the slightly moister and deeper soils of depressions and canyon bottoms. At lower elevations it may occur on northern slopes.

Utilization. Mountain mahogany ranks as good forage for all classes of livestock. New spring growth is highly preferred by livestock and big game. The persistent leaves are palatable until late fall. The species often is not available to livestock on winter range. Deer and elk eat leaves and twigs in summer and browse twigs in winter. It is a most valuable winter feed for deer. Plants withstand grazing very well. Most of the current production is available.

Propagation. This species sprouts following burning. A good crop of seedlings may be produced in favorable years. Fall seeding is usually preferred. Seedling establishment is inconsistent with drought and frost causing major losses.

Related Forms. Hybrid crosses occur with C. ledifolius. Cercocarpus species appear to have possibilities for improvement through selection.

Chrysothamnus nauseosus

Rubber Rabbitbrush

Description. Usually a low evergreen shrub, one to six feet tall. There are a number of recognized subspecies. The root system is deep and extensive. Fruit matures in October-November. The seed is an achene with numerous bristles which aid dissemination by wind.

Distribution. The species quickly invades disturbed sites and is widely distributed in the plains, foothills and intermountain valleys. It occurs on dry, open sites at low to moderate elevations in the sagebrush, pinyon-juniper and ponderosa pine zones. It is commonly associated with sagebrush, saltbush and various grasses but most frequently grows in dense stands. It grows in waste places, near dry washes and on foothills surrounding semi-desert valleys. On moderately alkaline flats in dense, extensive stands it may be associated with saltgrass, greasewood and povertyweed. Grows abundantly on deteriorated range sites.

Site Requirements. This species inhabits dry, sandy, gravelly, or heavy clay and alkali soils. It is found in open, sunny situations.

Utilization. The forage value, ordinarily, is very low. In fall, all classes of livestock lightly graze the flower stalks. Forage value varies with different varieties or locations. Some forms have summer and winter use by livestock and big game (mule deer and antelope).

Propagation. Rabbitbrush reproduces readily from seed and growth is rapid. Plants may be full grown in four years. However, young seedlings are highly sensitive to frost and drought. Collected seed is cleaned by rubbing in sacks and fanning. Aerial seedings in mixtures with grass have established and maintained themselves. Seed germinates without treatment a few days after sowing. Seedlings raised in containers and transplanted in the fall have been successful. Plants sprout vigorously following fire. McKell and Chilcote (1957) found seedlings as young as 3 months resprouted following extreme drought. When plant competition was removed the rabbitbrush produced flowers about 3 weeks earlier and three times as many, and increased current stem growth; however, seed viability did not increase. New shoot production following crown removal reached 4 to 6 inches and flowers were produced the first season.

Cowania mexicana stansburiana

Stansbury Cliffrose

Description. Tall evergreen shrub, 3 to 12 feet high; often tree-like and up to 20 feet tall. Plants are long-lived. The fruit is an achene with a feathery style, ripe in October, and wind disseminated. The seed crop is usually good.

Distribution. Not listed as occurring naturally in Idaho. It is a plant of dry hillsides and washes of the desert. It occurs from the woodland type to the lower fringe of the ponderosa pine and is frequently associated with juniper, pinyon, mountain mahogany, serviceberry, sagebrush and other woody species. Cliffrose may be found on favorable sites in the salt desert. It grows well on disturbed sites.

Site Requirements. Cliffrose is found on dry, well-drained, sunny sites. It is most characteristic of limestone areas, but also grows on granitic, volcanic and other igneous formations, often on east and south slopes. Plants beyond the seedling stage tolerate drought and heat well.

Utilization. Where abundant, it is an important and valuable browse for sheep, cattle and deer, especially in winter. Cliffrose is little used during spring and summer if other, more succulent forage is available. The brittle branches may be broken down by over-browsing.

Propagation. Good seedling years may be infrequent. Collect seed by stripping by hand. Clean dry seed by rubbing to remove plumes, and fanning. No other pre-planting treatment may be necessary. The value of stratifying this seed is uncertain. Fall and winter planting is best. Seedling transplants have been successful.

Related Forms. Cowania hybridizes readily with antelope bitterbrush, desert bitterbrush, and apache-plume.

Ephedra viridis - Green Ephedra
Ephedra nevadensis - Nevada Ephedra

Description. Jointed shrub, evergreen, one to 5 feet high, leaves scale-like. Gymnosperms. Flowers separate, usually dioecious. Fruit small, nut-like. Seed production is not good every year. The root system is deep and fibrous, but scarcely spreading.

Distribution. Ephedras are confined to arid areas on dry, open sites in valleys and on slopes principally in the sagebrush, pinyon-juniper, creosote bush and salt desert types. Nevada ephedra usually on the drier sites. Commonly associated with gramas, mountain mahogany, saltbushes, junipers and creosote bush. It is usually found as scattered bushes or clumps, but sometimes is in almost pure patches. Exposed canyon bottoms, dry washes, ridge tops and breaks with southern exposures are characteristic habitats.

Site Requirements. Ephedra occupies dry, sunny sites. It commonly occupies dry water courses where drainage is good and there is some subirrigation. It frequently grows in gravelly or rocky soils.

Utilization. These two species are moderately palatable to all classes of domestic stock and to deer. Younger stems are preferred. The Nevada species is somewhat coarser than the green. There is little summer use. Ephedras sometimes are important on winter ranges, especially during emergency periods. Quail, cottontail rabbits and mule deer utilize these species.

Propagation. Seedlings establish well from fall or winter seedings. Use the seed in mixtures. Once established, seedlings withstand extreme drought, but growth is slow (2 feet in 5 to 10 years). Ephedras are easily reproduced from stem cuttings. (Plummer, et al 1968)

Eurotia lanata

Winterfat

Description. Low, native shrub usually not over 2 feet high. Staminate and pistillate flowers separate but both usually on the same plant; some plants have complete flowers. Fruits are down-covered utricles; mature in August-October and are soon widely disseminated by wind. Plants may bear seed their first year, and produce a good crop almost annually. Growth is rapid with summer moisture. The root system is spreading but deep with a long taproot and numerous lateral roots.

Distribution. Widespread in western U.S., winterfat is commonly dominant and conspicuous over large areas. It is found on mesas and lower flats growing in pure stands or mixtures. It inhabits desert valley bottoms, pinyon-juniper foothills, ponderosa pine and mountain brush types. Winterfat is usually associated with saltbushes, rabbitbrush, sagebrush, greasewood and semi-desert bunchgrasses. It maintains itself well in grass mixtures.

Site Requirements. Dry, moderately alkaline, well-drained soils of plains, foothills and desert valleys. Open, sunny sites. In plant growth regions (including the Snake River Plains, Great Basin, and Southwest Desert) characterized as deficient in rainfall at all seasons. Temperatures and average duration of snow cover widely variable.

Utilization. Winterfat is valuable on winter ranges where it furnishes abundant, palatable and nutritious forage for sheep and cattle. Fruits are relished by grazing animals. Utilized by deer, elk and rabbits. It is not highly preferred by deer but other big game seek it (Plummer et al, 1968). Crude protein content is high. The species has been overutilized and replaced on many areas.

Propagation. Potentially, winterfat is one of the most valuable browse species for planting. It produces an abundant crop of viable seed. Seed is collected by hand stripping as soon as ripe. No cleaning is necessary except to remove debris. Germination of seeds has been greater than from fruits. Seeds are less subject to wind movement, are easier to handle and to cover when seeding (Springfield, 1970). However, removal of seeds from fruits is expensive and is not advocated by Plummer et al (1968). It is important to dry seed before storage. Winterfat seed loses much of its viability within two years. Seed from the taller strains of the species (e.g., from the pinyon-juniper belt in Utah) are best suited for winter big game ranges (Plummer et al, 1968). Pretreatment of seed is not necessary. Stands are readily established by direct seeding. Seed may be broadcast in late fall or winter (November in Utah), but germination can occur during cool weather and may begin two to five days after seeding.

Seedling establishment sometimes is best from early spring planting because of winter killing of fall-sprouted seedlings. Good establishment has resulted from aerially seeded mixtures with grasses in late fall and winter (Plummer et al, 1968). Winterfat is well suited for seeding on lime-bearing soils on south and west exposures in the mountain brush zone and on most lowlands (Plummer et al, 1955). It is easily grown under cultivation. Stem growth may be rapid, exceeding one foot in a single growing period (Dayton, 1931). Propagated or wild plants can be transplanted.

Studies relating to seeding winterfat conducted by Springfield (1968, 1970, 1971, 1972) in New Mexico provide the following information. Shallow seeding is essential. Much of the seed on the soil surface will germinate if there is a period of wet weather during fall and winter. A 1/16-inch planting depth was substantially better than greater depths regardless of soil moisture or texture. Few seedlings emerged from ¼-inch and none came from ½-inch depth. The best germination and survival came from seeds sown on the surface. Emergence was significantly better in clay than in sandy loam soil. The pH range was 7.1-7.8. Emergence was best in moderately dry soil and was least in nearly saturated soil. This may be influenced by soil texture and aeration. Emergence began the third day. Germination from seeds sown on the surface was 58 to 90 percent and from fruits 18 to 50 percent. The optimum germination temperature ranged from 50 to 80F. (seed from central N.M.). Germination began the second or third day and was practically complete within 5 days at 59F or higher. It exceeded 90 percent over a relatively wide range in temperature. Germination of winterfat seeds was influenced by moisture stress, temperature, and seed source. As moisture stress increased, germination was delayed and generally was reduced, regardless of temperature; but its effects would be less detrimental at relatively low temperatures. Number of fruits per pound, in two studies, ranged between 69-79M and 78-120M.

Springfield (1973a) tested seed of three size groups for germination. The seed was collected during November in New Mexico and tested under laboratory conditions. Total germination was higher for large (150,000/lb.) and medium (199,000/lb.) seeds than for small (310,000/lb.) seeds under all four temperatures tested. Large seed germinated 98 percent, small seed 76 percent at 45F. All germination occurred within 7 days; however, large seeds germinated more rapidly than small seeds at all tested temperatures.

Springfield (1973b) reported that winterfat seed stored in sealed containers under refrigeration or subzero temperatures retained 93 to 99 percent viability over a 3-year period. Seed stored in unsealed containers at room temperatures retained 46 percent viability, and under outside shed conditions only 3 percent.

Prunus virginiana

Chokecherry

Description. Native, deciduous, large shrub or small tree (3 to 20 feet or more). Forms thickets from root sprouts and survives fire well. Root system shallow with occasional deep penetration. Fruit is a drupe; ripe August-September; soon dispersed when ripe.

Distribution. Generally most abundant from foothills to the ponderosa pine belt in the mountains. Common along streams. Occupies mountain brush and pinyon-juniper types. May be associated with willow, alder, aspen and dogwood. In southern Idaho, it is usually at 5000 to 7500 feet.

Site Requirements. Usually on deep, rather fertile soils, but frequently does well on rocky, talus slopes and about rim rocks. Moist or relatively dry sites. Found around springs, seeps and along streams. Pure and brushy stands are largely limited to moist or well-drained, warm slopes or sandy flats.

Utilization. Browsed by livestock and big game. More often used by sheep than cattle. Young leaves when wilted, frozen or crushed may contain enough hydrocyanic acid to poison sheep (2-4 oz. green leaves per 100 lb. sheep) if not mixed with other forage. Elk and deer browse chokecherry, especially late in the season. Fruits utilized by pheasants, sharptailed grouse and other birds.

Propagation. One hundred pounds of fruit may yield 15 to 20 pounds of seed. Depulp the fruit and dry seeds if stored. Dry cold storage is best. Can establish from direct seeding. One-year old transplants have been successful.

Related Species. Prunus emarginata, a native, deciduous shrub or small tree, 3-15 feet in height. Fruit bitter. May form thickets on damp sites. Root sprouts. Occupies dry or moist soil on hillsides and streambottoms. Browsed by livestock and deer. Fruit utilized by birds and rodents.

Purshia tridentata

Antelope Bitterbrush

Description. Native, deciduous shrub, usually 2-6 feet high and sometimes reaching 15 feet. Flowers produced on twigs of previous year. Fruit an achene, ripens June or July and soon shatters. Twig growth follows flowering and continues into late summer. Leaves remain on the plant into early winter. Primary root penetrates several feet before major branching; however, numerous smaller roots occur near the surface. Root depth may extend to 15-18 feet. On good sites, plants may begin bearing fruit at 4-5 years of age. Old stands may be 60-70 years old.

Distribution. Bitterbrush is one of the most widely distributed of all western shrubs and is native to all eleven western states and southern British Columbia. If present, it usually is abundant and a conspicuous component of the vegetation. Found on semi-arid plains, foothills and slopes in sagebrush, pinyon-juniper, mountain brush, ponderosa pine, lodgepole pine and aspen types. It is often associated with big sagebrush, mountain mahogany, oak, pinyon and other pines, serviceberry and wheatgrasses.

Site Requirements. Commonly on deep, well-drained loam soils with good moisture-holding capacity. Soils are permeable to good depth; sandy, gravelly or rocky. Neutral or slightly acid soils (pH 6.0-7.3 in California) to a depth of 5 feet or more. Not usually found on saline or calcareous soils if within 3 feet of surface. Occupies dry, upland sites in full sun or light shade. Precipitation minimum generally is 12-14 inches (range 10-25 inches).

Utilization. Bitterbrush is the most important single browse species in many places. Its palatability usually is high, but varies. In many parts of Idaho, Utah, Nevada, Oregon and California it is a highly prized forage plant, but on the Boise and Sawtooth national forests in southwestern Idaho, it rates poor to fair for sheep and cattle. In Montana it is classed as fair for cattle. It is grazed principally in the fall, winter and spring. (Forest Service 1937) It is one of the chief browse plants for deer, elk and antelope and is especially important in winter and early spring. Bitterbrush remains green later than the associated bunchgrasses and late summer use by livestock sometimes directly competes with the requirements of deer on the winter range. Bitterbrush withstands heavy grazing well, but continued excessive use has reduced some stands. Rested plants will recover well if damage was not too severe. Seedling reproduction is poor on many heavily utilized ranges. Young plants that do get started remain stunted under heavy grazing, e.g., 15 year-old plants on an eastern Oregon deer winter range averaged 8 inches in height. A number of smaller mammals (various mice, ground squirrels and probably chipmunks) and insects utilize bitterbrush - especially the seeds.

Propagation.

Seed. At elevations below 3000 feet near Boise seeds generally ripen during the first week in July. The ripe fruits are usually hand harvested by tapping branches so the easily separated fruits fall into a container. Collections should be made during good years; the seed retains its viability well in dry, cool storage. Harvest must be carefully timed for the mature fruits readily shatter; also, they are soon gathered by rodents. Seed should be cleaned before use with a dewinger. One lot of 386 pounds of fruit cleaned to 106 pounds of seed (28 percent). Another collection of 600 pounds of field-run fruits from eastern Oregon yielded 365 pounds of clean seeds. A limited supply of seed usually is commercially available. It is best to use a local seed source for plants adapted to the site and climatic conditions. Seed production in quantity does not generally occur until plants are at least ten years old. Seed viability is 75 percent or better.

Seed treatment. Most natural seedlings arise from clusters of seeds planted by rodents during the previous summer. Fall seeding is preferred. There is no danger of fall-sprouting bitterbrush. Of course, this may be a factor with other species in a mixture. If seeds are cold-stratified to break dormancy, they must be planted promptly when ready and soil moisture content may be a critical factor. Quicker treatments, better suited to field planting, are with thiourea or sulfuric acid.

Seeding sites. Areas formerly supporting bitterbrush should be favorable provided the topsoil hasn't been lost. The best big sagebrush sites with a 10-12 inch minimum precipitation could produce successful seedings if the first growing season has at least average moisture. Higher vegetation zones should be more favorable. Unfavorable conditions include poorly-drained, saline or alkaline, shallow or hardpan soils. Very light soils may dry out faster than the seedling roots can penetrate. Some heavy soils, especially on south and west slopes are subject to frost heaving with subsequent high seedling losses. Seedlings are not competitive with established grass. In one Idaho planting 99 percent of emerged bitterbrush seedlings planted in cheatgrass died during the first year. Apparently bitterbrush seedlings can compete more successfully with either big sagebrush or rabbitbrush as studies showed bitterbrush roots having the fastest early growth.

Seeding. A clean, firm seedbed is necessary. Burns may need no further preparation. A number of trials show the best planting depth to be ½ to 1 inch. Usually the highest percent emergence was from ½ inch; however, emergence was earlier (around April 1 in southwest Idaho) and seedling loss to freezing or frost heaving was greater. Emergence from 1 inch depth generally is good and there may be less early loss due to rapid drying of the soil. Germination or emergence is nil from uncovered seed or seed placed at 2 inches or deeper. (Basile and Holmgren 1957)

Deep furrow drilling may be advantageous on dry sites. Where adapted, grain drills are recommended for seeding bitterbrush and grass together. They should be seeded in different rows. Row spacing for bitterbrush should be from 4 to 8 feet with intervening rows of grass. At this spacing the rates are 1½ to 2½ pounds of bitterbrush seed and 6 to 8 pounds of grass seed per acre. (Holmgren and Basile 1959) On a good site in northern California straight bitterbrush seed was drilled at 6 pounds per acre and produced 15,000 seedlings per acre. Survival of 1000 or more seedlings per acre after the first growing season has been considered satisfactory. Seed may be broadcast at 2 to 3 pounds per acre but the seed must be covered. Various hand implements have been used for spot seeding of about 6-8 seeds per spot.

On weed-free sites seedlings may grow 5 to 8 inches in height and root lengths reach three feet or more during the first growing season. As an average and especially under natural conditions top growth will be 2 or 3 inches. In one instance, under heavy competition, seedling height was 1½ inches; without competition height was 6 to 11 inches. In northern California, after three growing seasons, bitterbrush seedlings on a weed-free site averaged 26 inches in height compared to 18 inches under moderate competition and 4½ inches under heavy competition from other plants.

Two desirable characteristics of some forms of bitterbrush are sprouting and layering. As additional features these would be especially preferred in rehabilitation for soil stabilization and recovery from burning. A high percent of sprouting from the crown following fire occurs in some places including areas in southeastern Idaho and Utah; but is absent or rare in southwestern Idaho and Nevada (Plummer et al 1955). Blaisdell (1953) found many bitterbrush plants sprouting soon after a planned sagebrush burn on the upper Snake River plains in southeastern Idaho; however, bitterbrush density 15 years later was only one-half that of the unburned area. Of course, sprouting may also follow chopping or crushing of the crown. Layering-rooting from buds forming on branches at points where they touch the ground-is fairly common in parts of California, Oregon, and elsewhere. The low-growing, layering forms survive fire better, but tall forms provide more available winter browse in snow zones. (Plummer et al 1955)

Bitterbrush has been propagated successfully in the laboratory from stem cuttings and they have grown well after transplanting. This procedure would have application in developing stocks of special strains. (Nord 1959)

One-year old nursery-grown seedlings have been field planted. Except under very favorable conditions, the low survival may not equal the high expense.

Related Forms. Desert bitterbrush is an erect, native, evergreen shrub, 2 to 8 feet in height, found on southern ranges from southeastern California to Utah. It usually sprouts vigorously following fire. The soil requirements are similar to antelope bitterbrush. In its northerly range it associates with big sagebrush and pinyon-juniper. Its range overlaps with antelope bitterbrush. It is palatable to domestic stock and big game animals over a long season. Seed and seeding details are generally similar to antelope bitterbrush, but fall or winter seeding definitely is preferred.

Natural hybrids occur. The two bitterbrush species cross. Both species cross with Stansbury cliffrose and their fruiting characteristics are intermediate. Researchers are aware of the potential for improvement through breeding of these forms. (Plummer et al 1968)

Rhus trilobata

Skunkbush

Description. Native, deciduous shrub, 2 to 7 feet high, frequently growing in nearly pure stands. Sprouts and sometimes forms thickets. Very long roots. Fruit a drupe, in clusters; ripe in August-September, persists all winter.

Distribution. Adapted to a variety of soils. Along stream and canyon bottoms it sometimes is found with alder, serviceberry and chokecherry. It occurs commonly in the mountain brush and pinyon-juniper types. Occupies dry, rocky hillsides.

Site Requirements. Dry, well-drained sites in sun or some shade. Very drought-resistant. Grows well on depleted soils. Persists on wind-blown sandy soils.

Utilization. Variable value for wildlife. Palability usually low, but somewhat better in the southwest. Not a preferred food but important as a winter emergency ration. Slight browse value for deer and bighorn sheep. Reported to be well utilized in Colorado by elk and horses. Browsed by rabbits. A valuable cover plant for birds. Fruits (a good source of vitamin A) utilized, particularly in winter, by ruffed grouse, quail, prairie chicken, sage grouse, pheasant and other birds. Valuable as ground cover for erosion control.

Propagation. Sumac establishes well from seeding or transplanting. Fruits borne in clusters; 100 pounds yields about 50 pounds of seed. Fruits should be cleaned or dried before storage. Clean by rubbing or beating the dry, sacked fruit to break up clusters; fan; then macerate in water. Dormancy is related to both seed coat and embryo. Treat by soaking one hour in sulfuric acid and perhaps scarifying mechanically. For spring use, stratify seed for 2 months. Seedlings are reported to be very susceptible to damping-off fungus.

Related Species. Rhus glabra, smooth sumac, is a native, deciduous, thicket-forming shrub. The fruit is a drupe, ripe in September-October, and persists all year. Similar distribution and site requirements to skunkbush. Favors slightly acid soils. Spreads well-especially following fire. Moderate palatability in winter for deer. Fruit used by birds, as for R. trilobata, and also recorded for turkey, Hungarian partridge and mourning dove. Clean and treat seed as for skunkbush (omit maceration). Native rootstocks easily transplanted. (Plummer et al, 1968).

Sambucus caerulea

Blue Elderberry

Description. A large, native, deciduous shrub reaching 6 to 12 feet or more in height. Fruit is a berry-like drupe borne in large, flat-topped clusters, usually abundant, ripe in August and remaining available for several months.

Distribution. Usually found growing individually among other woody vegetation rather than as extensive stands. It occurs in burned-over range in sagebrush, pinyon-juniper, ponderosa pine, mountain brush and aspen types. It is scattered but common along streams, in canyons, and on moist flats or slopes. Usually it is on moist or subirrigated sites. It associates with chokecherry, serviceberry and various other shrubs. (Dayton).

Site Requirements. Well-drained but moist sunny sites on either light or heavy soils.

Utilization. The foliage is most palatable in the fall from the time fruit ripens until frost or later. The fruit, leaves, twigs and buds are all eaten. Sheep and cattle make little use of it in spring. The large plants are often out of reach of sheep. Elderberry provides good browse for deer and elk. Birds including grouse, quail and pheasants utilize the fruits.

Propagation. Blue elderberry can be established by direct seeding, seedling transplants, cuttings, or from rootstocks. Sprouts arise freely from the roots and may reach full height in one season (Van Dersal). Fire releases seeds. One hundred pounds of fruit will yield about 6 pounds of seed. (27,000 dried fruits per pound) Harvest fruit when ripe and remove the pulp by macerating in water. Dry the fruits or seeds before storage. Excessive drying may retard germination. The seed apparently has both a dormant embryo and a hard seed coat. It needs heat or acid treatment for the seed coat, and either fall planting or cold stratification for spring seeding. Some planted seed will germinate the second year. Establishment may be erratic, but once established it grows rapidly.

Symphoricarpos occidentalis

Western Snowberry

Description. A native, deciduous, erect shrub usually less than 3 feet in height. Leaves appear early in the season. Fruit is a berry-like drupe, ripe in the fall, and very persistent on the bush. The plant often spreads from rhizomes to form dense colonies.

Distribution. Typically found in the Rocky Mountains or northern plains. It occupies open prairies and moist, low ground along streams or lakes. In the mountain brush and ponderosa pine types it associates with mountain mahogany, bitterbrush, serviceberry and other shrub species.

Site Requirements. Moderately dry or moist, well-drained soil; open, sunny locations.

Utilization. This is an important forage species for livestock. It provides very good winter browse for cattle and generally is rated fair for sheep, deer and elk. It is valuable for erosion control, and is a good honey plant (Van Dersal). Snowberry provides good cover and food for birds and small mammals.

Propagation. Commercial seed, when available, may be dried fruit or cleaned seed. Seeds are planted in caches by rodents. There is pronounced seed dormancy. Acid treatment breaks down the tough seed coat. A long period of cold stratification should precede spring seeding, or seed in the fall. Propagate vegetatively from stem or root cuttings, or wild transplants.

Related Species. S. oreophilus, mountain snowberry, is a native, low-growing and sometimes trailing shrub. It produces stolons. Montane distribution; sometimes it is abundant and in almost pure stands. It occurs with pinyon-juniper, ponderosa pine, spruce-fir and aspen. Found in forest openings, it is seldom in dense shade (Dayton). The species is valuable spring and summer browse for livestock and deer. It is useful for establishing cover on eroded sites (Plummer et al, 1968). Sprouting follows fire. Trailing branches may root. Fall and winter seeding has been successful. Propagate as for S. occidentalis.

S. albus, common snowberry, is an erect, native shrub six feet or more in height. Less rhizomatous than occidentalis, it may, however, form colonies. Fruit is available all year. Wide distribution, sometimes dominant over large areas. On the plains and hills at low or moderate elevations, in woodlands or on open slopes. This species is considered to be a most important browse for sheep and cattle, especially in late summer and fall (Dayton). Slight importance for deer, but used by many birds including

grouse, quail, pheasant, partridge, and sharptail grouse. Propagate as for occidentalis.

S. longiflorus, desert snowberry, is commonly found in the pinyon-juniper type and extends into big sagebrush on lower, drier sites down to 8 or 9 inches minimum precipitation. The upper limits of its range overlap with S. oreophilus in the mountain brush and ponderosa pine zones. Both species can be transplanted or seeded. Wild plants of snowberry transplant successfully. Desert snowberry has wide ecotypic variation. (Plummer et al, 1968)

H. Seeding and Planting

1. Seeds*

Types. From the standpoint of collection and sowing, seeds may be: 1) True seeds extracted from the fruits, e.g., locust seeds from the pod. Extraction is usually by drying and heat treatment. 2) Dry fruits such as nuts and acorns. The entire fruit is seeded although sometimes appendages as wings and plumes are removed to facilitate handling. 3) Fleshy fruits, as berries, drupes (cherry) and pomes (apple). These seeds are extracted by macerating the fruit in water and floating off the fleshy parts. Sometimes fleshy fruits are dried and sown without extracting seeds. (Woody Plant Seed Manual, 1948)

Collection. Seed of most native shrub and forb species desired for wildlife habitat rehab projects is not available commercially and must be collected from wild stands. Seed of native species, collected or purchased, should originate in the same locality or come from an area with a similar climate. Experimental field plantings have been initiated for some species (Plummer, 1968). All wild species do not produce good crops of seed every year. Harvest enough during good seed years to meet several years needs. Collectors should examine seed samples for good quality on sites to be harvested. Collection procedures include shaking or beating limbs causing seeds to fall on canvas or into hoppers, e.g., bitterbrush, mountain mahogany. Stripping seeds by hand is recommended for fourwing saltbush, winterfat, rabbitbrush and sagebrush. Sagebrush and fourwing seeds, if well-ripened and dry, may be collected by beating bushes. Seeds of most native forbs are collected by stripping (e.g., balsamroot, vetch). Some seeds shatter when ripe, so must be collected promptly (bitterbrush, mountain mahogany, cliffrose, ephedra). Such species must be watched carefully and advance preparations must be made for timely harvest. Some fleshy fruits are more persistent but often are quickly gathered by wildlife (chokecherry, currant, serviceberry, elderberry). Persistent seeds that can be harvested over longer periods of fall or early winter are: winterfat, saltbush, rabbitbrush and sagebrush. (Plummer, 1968) Seed falling earliest sometimes is of poorest quality. Collected fruit should be mature; slightly unripe seed cannot be stored as well as fully ripe seed. (Van Dersal, 1939)

Size. The larger seeds of a plant species usually produce more vigorous seedlings than smaller seeds. Sometimes seedling emergence is also higher from larger seeds. Large seeds of winterfat germinated more rapidly and had greater total germination percentage than smaller seeds in laboratory tests. (Springfield, 1973) Piatt (1973) found germination to be significantly higher for large seeds of true mountain mahogany than for medium or small sized seeds. Germination in some cases may be inversely related to

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*See also Bureau Manual 7413 Seeding. Appendix 5 Shrub and forb seed data.

seed size, as in fourwing saltbush. (Plummer et al, 1966) Van Dersal (1939) noted that the number of seeds per pound may be higher (smaller seeds) at the northern and higher portions of a species' range. Seed size varies widely between years on any given site.

Cleaning. Seeds are separated from some fruits to improve germination, facilitate handling and planting, and improve storage conditions. Most dry seeds are run through a hammermill and fan to remove extraneous material (saltbush, winterfat, sagebrush, rabbitbrush), or a dewinger (bitterbrush, ephedra) and fan. Pulpy fruits should be cleaned immediately or dried before storage. (Plummer, 1968)

Storage. Seeds of most species can be stored several years without significant loss of viability provided they are kept in a dry, cool, ventilated, mouseproof container and location. Temperature greatly influences the keeping quality of seed, generally 35-40F is satisfactory. Hafenrichter et al (1965) found that fungicide treatment had an adverse effect on stored grass seed but hammermill processing did not. Cool and dry conditions were best; cool and humid conditions were worst for storage -- for example, orchard grass with an original germination of 95 percent, was 80 and less than 5 percent respectively after 14 years. A number of grasses, including Bromus tectorum retained high viability and Indian ricegrass greately improved after 14 years of dry storage. Several important forbs gave similar results. Sainfoin originally 83 percent was 45 percent after 14 years; cicer milkvetch increased from 11 to 67; and small burnet starting at 69 percent increased to 85 after 8 years and retained 47 percent germination capacity after 14 years.

Dormancy. Some seeds are ready to germinate as soon as they mature but most seeds of woody species, at least in the cooler regions, undergo a dormant period. Dormancy may be due to a hard or impermeable seed coat, or to incomplete development of the seed, or both. Seed coat dormancy occurs, for example, in some legumes, buckthorns and sumacs; treatments include soaking in hot water or acid, or mechanical scarification. Internal dormancy is fairly common in woody species including bitterbrush, fourwing saltbush, and mountain mahogany; the usual treatment is cold stratification. Fall sowing for spring germination normally satisfies the dormancy requirement. Chemical treatment sometimes is used to break internal dormancy. Some shrubs (e.g., many species of ceanothus) have both types of dormancy and should be given both types of treatment. (Woody Plant Seed Manual, 1948) Cold stratification is largely a nursery practice used to break internal dormancy. Seeds are placed in layers with sand, peat, vermiculite or similar material, kept moist, and usually at around 33-38F. The duration of treatment varies with species and is begun timely so that planting conditions are favorable when seed is ready. Seeds may germinate in stratification if held too long; they are then easily damaged and hard to handle. If stratified seeds dry out before germination, they generally return to a dormant state. Scarification by mechanical abrasion, or hot water soaking before stratification, is recommended for species with hard

seed coats (e.g., ceanothus or chokecherry), but not for those with permeable seed coats (e.g., bitterbrush). Peterson (1953) found potential germination of several browse species to be adversely affected by scarification prior to fall planting. Boyd (1956) got 83 percent germination of bitterbrush either with two month's cold stratification or 50 minutes soak in concentrated sulfuric acid versus one percent with no treatment. Comparable treatment of true mountain mahogany gave 71, 52 and one percent, respectively. Chemical treatment sometimes will break seed dormancy. Bitterbrush seeds immersed in a 3 percent aqueous solution of thiourea for 3 to 5 minutes and then air dried before use or storage have germinated well. Treated seeds should be tested for viability.

Testing. Seed testing is essential in determining seeding rate. Seeds are generally tested for genuineness, purity, number per pound, moisture content and viability. Special attention should be given to assuring that seeds are of quality good enough to make plantings worthwhile. When necessary, seed samples can be analyzed at a seed laboratory to determine viability and purity. Viability of seed older than 3 years should always be checked. Seed of herbaceous species and most shrubs usually should have a purity of at least 90 percent and a germination of 85 percent, with a pure live index (purity x germination) of not less than 75 percent. Some species difficult to clean must be accepted at much lower standards. Purities of 8 to 10 percent are acceptable for big- and black sagebrushes, and rubber- and Douglas rabbitbrushes. Winterfat seed purity may be acceptable at 25 to 50 percent; fourwing and other saltbushes at 35 to 50 percent. (Plummer, 1968; Woody Plant Seed Manual, 1948) Theoretically the number of seeds per pound multiplied by the percent germination should equal the number of usable plants to be expected per pound of seed. Actually the number is often 1/3 to 1/5 of the theoretical figure (Van Dersal, 1939).

2. Seeding*

General. Burned rangelands should be seeded (if necessary) before the following growing season or the advantages of the clean seed bed are largely lost. Weeds rapidly take over and provide severe competition for shrub seedlings. The hottest fires destroy practically all seeds on or near the soil surface and provide a relatively weed-free seedbed the following year. The chances for success are slight on burns of low heat intensity. A light burn will usually leave a short, charred stubble or turf with little mineral soil completely bared. Poor results may be expected from seeding on any but the hottest parts of such light burns. Hot spots can be hand seeded. Bitterbrush drilled with a grass is likely to become established most readily on the hot spots and on areas severely burned. (Holmgren and Basile, 1959)

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*See Bureau Manual 7410, Appendix 1, Range Seeding Equipment Handbook for Equipment Details . Appendix 4 Shrub and forb seeding data.

Drilling. This method gives seed the most even distribution and provides the best control of quantity and planting depth with economical use of seed. Conventional farm equipment may be used where site conditions permit. The rangeland drill can be used to seed browse species. Hubbard (1964) seeded straight bitterbrush mixed with rice hulls for bulk at a ratio of 8:3 (hulls:seed) to reduce damage to seed and improve its distribution. He recommended disconnecting seed agitators and adjusting settings to seed about 6 pounds per acre. Check settings by bagging the drop spouts and running the drill over a measured distance. On light, dry soils seeded in spring use of press wheels on the drill are recommended for firming the soil. For unplowed seedbeds, as on some burns, weights may be needed on the drill disk assembly. Avoid seeding small quantities of shrub species mixed with grass seed. If both are used on the same area, either drill separately or partition the drill box to permit drilling shrub seed from the two end spouts with one or two adjacent spouts plugged and leaving the large central portion for grass. A specially designed browse seeder has been developed as described in the Range Seeding Equipment Handbook. This implement could be used in alternate rows with the rangeland drill. There is also a seed-dribbler attachment for mounting on crawler tractors; seed is covered by the cleats. Modified hand corn planters and similar hand-held equipment have been used for planting browse seed.

Broadcasting. Browse seed may be broadcast aerially or from the ground. This method is used on rangelands too rough or rocky for drilling equipment. Airplanes may be preferred on large projects, i.e., 200 acres or more. Ordinarily the seeded ground is chained immediately to cover the seed. Fourwing saltbush has been aerially seeded successfully on snow with chaining delayed until late winter. (Plummer et al, 1966) Aerial seeding on deep ash should precede the first rainfall which compacts, and covers the seed; otherwise, cover the seed by chaining. On the ground, cyclone-type seeders either attached to a vehicle or hand held may be recommended for small, isolated tracts of less than 5 acres. They are also used to seed irregular, rough, steep or rocky spots within drilled seedings. (Holmgren and Basile, 1959)

3. Transplanting

Seedlings of antelope bitterbrush, fourwing saltbush, big sagebrush, black sagebrush, rubber rabbitbrush, chokecherry and many other shrubs can be transplanted directly from native stands in the field, and from nursery or greenhouse stock. Early spring planting has produced best results. Soil must be moist for planting to be successful. Transplanting is one means of establishing shrubs on a small area but, as in forestry, it is considerably more expensive than seeding. It may be used to establish a small stand when seed is scarce or as a future seed source. A few species such as willows are commonly reproduced from stem cuttings which produce roots. Root stocks of thicket-forming shrubs (e.g., mountain snowberry) can be transplanted. Occasionally rhizomes, tubers and bulbs may be the best source of transplant stock. Transplanting usually is done by hand, however, mechanical tree planting machines are available for use on favorable sites of large area.

I. Plummer's Principles and Procedures for Successful Range Restoration

1. Change in plant cover must be determined, by rational criteria, to be necessary and desirable.

2. Terrain and soil type must be suitable to making the change selected.

3. Precipitation must be adequate to assure establishment and survival of planted species.

4. Competition must be low enough to assure that the desired species can become firmly established.

5. Only species and strains of plants adapted to the area should be planted.

6. Mixtures of plant types rather than single species should be planted.

7. Sufficient seed of acceptable purity and viability should be planted to insure getting a stand.

8. Seed must be covered sufficiently.

9. Planting should be done in a season that gives promise of optimum conditions for establishment.

10. The planted area must not be overgrazed.

Plummer et al, 1968

J. Management.

1. Protection. Newly rehabilitated areas require protection. Livestock use of new seedings is delayed until young plants can withstand trampling and uprooting. (Manual 4112.17) Woody plants which take longer to become established normally require a longer period of protection than do grasses. This may be four or five years. On some Idaho ranges it takes 12 to 15 years for seeded bitterbrush to reach full production (Holmgren and Basile, 1959). This needed protection from animal use applies to big game and other wildlife as well as to livestock. Wildlife numbers may need to be reduced during the period of establishment. This, of course, requires cooperation of the State wildlife agency for species under their management. In addition, serious losses frequently occur due to foraging by small mammals such as jackrabbits, mice, gophers, chipmunks and ground squirrels; and from insects, especially cutworms and grasshoppers. (Holmgren and Basile, 1959; Plummer et al, 1968). Approved control treatments may be needed to protect seedings (see Manual 9220 Pest Control). Browse revegetation is a high-cost, often emergency-type action which justifies providing the extra protection necessary for success. Following successful seedling establishment, its maintenance will be best assured by continued conservative management.

2. Evaluation. Seedings should be examined periodically, or at least occasionally, to evaluate their success. It is especially recommended that for seedings of browse or forbs the evaluation details be made a matter of record for future use in the district. Note species survival and production as related to site characteristics, climatic factors, seed sources, pre-planting treatments, planting method, seed mixture used, and perhaps other factors. Note particular problems and how to eliminate or avoid them in the future.

3. Research. Information gaps or problems, as may be revealed for example by the evaluation of seedings, may indicate needed research. There is a continuing need for field testing various native and exotic plant species, and the improved strains and hybrids as they are developed. There is a particular shortage of shrub and legume plants having the desired qualities which are adapted to the harsh sites of the 8 to 10 inch precipitation zone. On native ranges reliable techniques are needed for predicting recovery of the various plant species following fires of different intensities on diverse sites.

PLANT REFERENCE LIST

Botanical Name	Common Name	*Symbol
Acer sp	Maple	
Achillea millefolium	Western yarrow	
Agoseris sp	Mountain dandelion	
Agropyron cristatum	Fairway crested wheatgrass	
Agropyron dasystachyum	Thickspike wheatgrass	
Agropyron desertorum	Standard crested wheatgrass	
Agropyron intermedium	Intermediate wheatgrass	
Agropyron smithii	Western wheatgrass Bluestem wheatgrass	
Agropyron spicatum	Bluebunch wheatgrass	
Agropyron trichophorum	Pubescent wheatgrass	
Allium sp	Onion	
Alnus tenuifolia	River alder	
Amaranthus retroflexus	Redroot	
Ambrosia sp	Ragweed	
Amelanchier alnifolia	Common serviceberry	Amal
Amsinckia tessellata	Fiddleneck	
Apocynum sp	Dogbane	
Arctostaphylos sp	Manzanita	
Artemisia arbuscula	Low sagebrush	Arar
Artemisia cana	Silver sagebrush	
Artemisia frigida	Fringed sagebrush	
Artemisia nova	Black sagebrush	Arno
Artemisia tridentata	Big sagebrush	Artr
Artemisia tripartita	Threetip sagebrush	
Artemisia sp	Longleaf sagebrush	
Aster chilensis	Pacific aster	
Aster modestus	Aster	
Astragalus cicer	Chickpea milkvetch	
Astragalus convallarius	Timber poisonvetch	
Astragalus falcatus	Sicklepod milkvetch	
Astragalus sp	Three-leafed milkvetch Locoweed	
Atriplex canescens	Fourwing saltbush	
Atriplex confertifolia	Shadscale	
Atriplex nuttallii	Nuttall saltbush	
Balsamorhiza sagittata	Balsamroot	Basa
Berberis repens	Oregon grape	
Bouteloua sp	Grama grass	
Bromus tectorum	Cheatgrass	
Calochortus macrocarpus	Sego lily	
Ceanothus sanguineus	Redstem ceanothus	
Ceanothus velutinus	Snowbrush	Ceve

* Symbol designated for species as listed in tables.

Botanical Name	Common Name	Symbol
Cercocarpus ledifolius	Curlleaf mountainmahogany	Cele
Cercocarpus montanaus	True mountainmahogany	
Chrysothamnus nauseosus	Rubber rabbitbrush	
Chrysothamnus viscidiflorus	Douglas rabbitbrush	
Cornus sp	Dogwood	
Cowania mexicana	Cliffrose	
Crataegus sp	Hawthorn	
Crepis acuminata	Tapertip hawksbeard	Crac
Dactylis glomerata	Orchard grass	
Dipsacus sylvestris	Teasel	
Distichlis spicata	Saltgrass	
Elaeagnus angustifolia	Russian olive	
Elymus junceus	Russian wildrye	
Ephedra nevadensis	Nevada ephedra	
Ephedra viridis	Green ephedra	
Ephedra sp	Jointfir	
Eremocarpus setigerus	Turkey mullein	
Eriogonum sp	Eriogonum	
	Wild buckwheat	
Erodium cicutarium	Filaree	
	Storksbill	
Euphorbia sp	Spurge	
Eurotia lanata	Winterfat	
Fagopyrum esculentum	Buckwheat	
Fallugia paradoxa	Apache-plume	
Festuca idahoensis	Idaho fescue	
Geranium sp	Geranium	Gesp
Gilia inconspicua	Gilia	
Gramineae	Grasses	Gram
Guterierrezia sp	Snakeweed	
Haplopappus sp	Goldenweed	
Hedysarum boreale	Utah sweetvetch	
Helianthus annuus	Sunflower	
Holodiscus discolor	Oceanspray	
Iva axillaris	Povertyweed	
Juniperus monosperma	Oneseed juniper	
Juniperus occidentalis	Western juniper	Juoc
Juniperus osteosperma	Utah juniper	Juos
Juniperus scopulorum	Rocky Mountain juniper	
Lactuca ludoviciana	Lettuce	
Lactuca serriola	Prickly lettuce	
	Chinese lettuce	
Larrea divaricata	Creosotebush	
Lolium sp	Ryegrass	
Lomatium sp	Lomatium	Losp
Lonicera tatarica	Tatarian honeysuckle	
Lupinus argenteus	Silvery lupine	
Lupine sp	Lupine	Lusp
Madia sp	Tarweed	

Botanical Name	Common Name	Symbol
Malva sp	Mallow	
Medicago hispida	Burclover	
Medicago lupulina	Black medic	
Medicago sativa	Alfalfa	
Melilotus albus	White sweetclover	
Melilotus officinalis	Yellow sweetclover	
Onobrychis viciaefolia	Sainfoin	
Opuntia sp	Pricklypear	
Oryzopsis hymenoides	Indian ricegrass	
Penstemon sp	Penstemon	Pesp
Philadelphus lewisii	Syringa	
Phlox sp	Phlox	
Physocarpus malvaceous	Ninebark	
Pinus monophylla	Singleleaf pinyon pine	Pimo
Pinus ponderosa	Ponderosa pine	
Poa secunda	Sandberg bluegrass	
Polemonium albiflorum	Skunkflower	
Polygonum douglasii	Douglas knotweed	
Populus tremuloides	Quaking aspen	Potre
Populus trichocarpa	Black cottonwood	Potri
Prunus emarginata	Bitter cherry	Prem
Prunus virginiana	Chokecherry	Prvi
Purshia glandulosa	Desert bitterbrush	
Purshia tridentata	Antelope bitterbrush	Putr
Quercus gambelii	Gambel oak	
Quercus sp	Oak	
Rhamnus sp	Buckthorn	
Rhus glabra	Smooth sumac	
Rhus trilobata	Skunkbush sumac	
Rhus sp	Sumac	
Ribes aureum	Golden currant	Riau
Ribes sp	Gooseberry Wild currant	
Rosa woodsii	Wood rose	Rowo
Rosa sp	Rose	
Rubus sp	Blackberry, raspberry	
Rumex crispus	Dock	
Salix sp	Willow	
Salsola Kali	Russian thistle	
Sambucus caerulea	Blue elderberry	
Sanguisorba minor	Small burnet	
Sarcobatus vermiculatus	Greasewood	
Shepherdia canadensis	Russet buffaloberry	
Sitanion hystrix	Squirreltail	
Solanum sp	Nightshade	
Sorbus scopulina	Mountain ash	
Sphaeralcea sp	Globemallow	
Spiraea sp	Spiraea	

Botanical Name	Common Name	Symbol
Sporobolus cryptandrus	Sand dropseed	
Stipa comata	Needle and thread	
Stipa thurberiana	Thurber needlegrass	
Symphoricarpus albus	Common snowberry	
Symphoricarpos longiflorus	Desert snowberry	
Symphoricarpus occidentalis	Western snowberry	
Symphoricarpos oreophilus	Mountain snowberry	
Symphoricerpos vaccinoides	Snowberry	Syva
Taeniatherum asperum	Medusahead	
Taraxacum officinale	Common dandelion	
Tetradymia canescens	Horsebrush	
Tragopogon dubius	Salsify	
Tragopogon sp	Goatsbeard	
Trifolium repens	White clover	
Typha sp	Cattails	
Urtica dioca	Nettle	Urdi
Vicia sp	Vetch	
Wyethia amplexicaulis	Mules ears	Wyam

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Shrub Response to Fire

Species		Literature Cited
	SPROUTING	
Acer	glabrum	59, 60
Amelanchier	alnifolia	21, 34, 39, 54, 59, 60
Artemisia	cana	2, 39
Artemisia	tripartita	2, 3
Atriplex	canescens	11
Ceanothus	sanguineus	59
Ceanothus	velutinus	39, 50
Cercocarpus	montanus	
Chrysothamnus	nauseosus	3, 22, 36, 52
Chrysothamnus	viscidiflorus	
Eurotia	lanata	11
Holodiscus	discolor	54, 59
Philadelphus	lewisii	39, 54, 59
Physocarpus	malvaceous	21, 52, 54
Prunus	emarginata	34, 39, 54, 59
Prunus	virginiana	21, 34, 39, 52
Purshia	glandulosa	34, 39
Purshia	tridentata	3, 26, 36
Quercus	gambelii	21
Rhus	glabra	34, 52
Rhus	trilobata	11, 39, 52
Ribes	viscosissimum	60
Rosa	sp.	21, 54
Salix	scouleriana	59, 60
Salix	sp.	39, 52, 54, 57, 59
Sambucus	coerulea	34, 39, 52
Sambucus	racemosa	60
Spiraea	sp.	52, 54
Symphoricarpos	albus	9, 39, 52, 54
Symphoricarpos	occidentalis	52
Symphoricarpos	oreophilus	3, 9, 34, 36, 52, 60
Tetradymia	canescens	3
	NON-SPROUTING	
Artemisia	arbuscula	39
Artemisia	nova	39
Artemisia	tridentata	3, 33, 39
Atriplex	canescens	39
Atriplex	confertifolia	39
Atriplex	nuttallii	39
Ceanothus	velutinus	60
Cercocarpus	ledifolius	39
Chrysothamnus	nauseosus	39
Chrysothamnus	viscidiflorus	39
Cowania	mexicana	34, 39
Ephedra	nevadensis	39
Ephedra	viridis	39
Eurotia	lanata	39

Shrub Response to Fire

Species	NON-SPROUTING	Literature Cited
Juniperus	monosperma	In 57
Juniperus	occidentalis	39, In 57
Juniperus	osteosperma	In 57
Juniperus	scopulorum	In 57
Purshia	tridentata	3, 30, 39, 54
Ribes	sp. (most sp.)	39
Sorbus	scopulina	57, 60
Tetradymia	canescens	39

On-Site Appraisal of Range Fires
Effect on Wildlife Habitat

Is the boundary description reasonably accurate?

Is this a high priority area for wildlife?
(Refer also to data from Preliminary Action)

Is this a major burn -- large and severe?

Is the ground cover of plants and litter largely destroyed?

Have the desirable, major plant species apparently been destroyed?

List: 1.

2.

3.

Have the undesirable, major plant species apparently been destroyed?

List: 1.

2.

3.

Condition of the Principal Food and Cover Plants

Species	Condition

Are management changes, in any land use, necessary because of the fire's effect on the wildlife habitat?

If so, jot down apparent problems:

1.

2.

3.

Can satisfactory natural recovery be expected?

Does the Watershed Staff recommend treatment?

If rehab is recommended, are the soil and moisture factors sufficiently favorable for habitat planting and/or seeding?

What are the site limiations?

Are other treatments needed, i.e., protective fencing?

Coordination follow-up:

- Review priorities (MFP), land use decisions, plans, commitments.
- Secure cooperation of state wildlife agency, as needed.
- If emergency management changes are recommended for other resource uses, are they compatible with wildlife use? Recommend modification if needed.
- If emergency management changes are recommended for the benefit of wildlife, are they compatible with the affected uses? Compromise may be necessary.
- Wildlife seeding and planting recommendations will need to be coordinated with other resource plans.
- Streams or reservoirs may require special attention.
- Rare or endangered species habitat may require special attention.

Appendix 3
(G)

Seed mixtures for the big sagebrush type*

Species	Precipitation 11 - ins.		11 + ins.	
	Broad-cast	Drill	Broad-cast	Drill
	Pounds per acre			
Grasses:				
Fairway crested wheatgrass	3	2	4	2
Standard crested wheatgrass	2	1	0	0
Bearded bluebunch wheatgrass	1/2	1/2	1	1/2
Bluestem wheatgrass	1/2	1/2	1	1/2
Intermediate wheatgrass	1/2	1/2	1	1
Pubescent wheatgrass	1/2	1	1	1
Russian wildrye	1	1	1	1
Forbs:				
Alfalfa (Rambler, Nomad, Ladak)	1	1	1	1
Utah sweetvetch	0	0	1/2	1/2
Arrowleaf balsamroot	1/2	1/4	1/2	1/2
Small burnet	0	0	1/2	1/2
Shrub:				
Fourwing saltbush	1	1/2	1	1/2
Rubber rabbitbrush	1/2	1/2	1/2	1/2
Totals	11	8-3/4	13	9-1/2

Note: May add 1/4 to 1/2 lb. sagebrush seed to any mixture.

* Table 5 in Plummer et al 1968.

Shrub and forb seed data

Shrub Seed *	Fruit ripe and available	Seed Cleaning	Clean Seed Per lb.	Acceptable Purity	Storage Duration	Dormancy-breaking treatment	Germination
	dates		M	%	yrs.	(if spring seeded)	%
Bitterbrush			17-23				
antelope	Jun-Jul	Dewinger and fan	15	90	5	Stratify 1-2 mo.	70-80+
desert			20				78-82
Chokecherry	Jul-Sep	Macerator; fan when dry	4 6	95	5	Stratify 3-4 or 5 mo.	40-45
Cliffrose	Jul-Aug	Rub and fan; or macerate dry and fan	65 92	85	5-6	Need to stratify uncertain	75-95
Currant			356				
golden	Jul-Aug	Macerate, dry and fan	217	95	5	Stratify 3 mo.	50-74
Elderberry	Aug-Oct	Macerate, dry and fan	216 117-126	90	5	Acid plus stratify 3 mo.	Low 8
Honeysuckle			165				
Tatarian	Jul-Aug	Macerate, dry and fan	142	90	5	Stratify 1-2 mo.	65
Jointfir							
green	Jul-Aug	Dry, fan, dewinger, fan	25	90	5		82-92
Nevada	Jul		20	95			86-91

*Multiple entries reflect different sources of information.

Shrub Seed	Fruit ripe and available	Seed Cleaning	Clean Seed Per lb.	Acceptable Purity	Storage Duration	Dormancy-breaking treatment	Germination
	dates		M	%	yrs.	(if spring seeded)	%
Mountain Mahogany curlleaf	Jul-Aug	Hammermill and fan	52 40-50	90	10	Stratify 1-3 mo.	70-30
true	Aug-Sep		59 40-42	80			90- 22
Rabbitbrush rubber	Oct-Dec	Hammermill and fan	693 335	10	1-2	None	30 98-80
Sagebrush big	Nov-Dec	Hammermill and fan	2500	10	2	None	98-45 8,80-55
black	Oct-Nov		900				
Saltbush fourwing	Oct-Nov	Hammermill and fan	55	95	5	Scarification. Storage 1 yr. if seed is dry.	47 30-60
Serviceberry common	Jul-Sep	Macerate; rub and fan when dry	45 82	95	5	Stratify 6 mo.	50 95
Snowberry Mountain	Aug-Sep	Macerate; rub and fan when dry	54	90	3	Acid and stratify 4-6 mo.	67-78
Snowbrush	Jul-Aug	Sieve chaff	71-152	95	Durable	Hot water then stratify 3 mo.	68-73
Sumac skunkbush	(all year) Aug-Oct	Dry, rub & fan then macerate	19-20	90	5	Acid plus stratify 2 months	10
smooth	Sep-Oct	Rub and fan	62-68			Acid. Scarification may help	4

Shrub Seed	Fruit ripe and available	Seed Cleaning	Clean Seed Per lb.	Acceptable Purity	Storage Duration	Dormancy-breaking treatment	Germination
	dates		M	%	yrs.	(if spring seeded)	%
Winterfat	Sep-Oct	Hammermill and fan	90,112 208-255 Lg. 150 Med 199 Sm. 310	50	1-3	None. Use fruits	18-50 98-58

Forb Seed *	Fruit ripe and available	Seed Cleaning	Clean Seed Per lb.	Acceptable Purity	Storage Duration	Special Treatment	Germination
	dates		M	%	Yrs.		%
Alfalfa	Commercially Available		212 225	99		Inoculate	85-90
Aster Pacific	Sep-Oct	Dry, fan	2,668	20	5		44-59
Balsamroot	Jun-Jul	Dry, fan macerator-chopper, and fan	55	95	5		36-52
Burnet small	Aug-Sep	Dry, fan	55	95	5-8		70-95
Milkvetch chickpea	Aug-Mar	Dry and chopper-macerator, fan	114 145	95	20	75% hard seed Scarify	75 70-85
Milkvetch sicklepod	Jul-Aug		115	95	20	Acid and Stratify 3-4 Mo.	54-92
Sainfoin	Commercially Available		18	90	8		75 85
Sweetclover	Commercially Available		260	99	Durable	Inoculant same as alfalfa. Scarify	85
Sweetvetch	Jul-Aug	Dry, fan	34	90	5	Fumigate	50-65

*Multiple entries indicate different sources of information.

Shrub and forb seeding data

Seeding Shrubs	Seed - Lbs./AC				Depth to Cover	Season	Minimum Precip.	Soils
	Drill		Broadcast					
	Single	Mixture	Single	Mixture	Ins.		Ins.	
Bitterbrush antelope desert	6	1-2		2-3	1/2-1	Fall	10-12	Non-alkaline
Chokecherry	10-25				1/2			
Cliffrose		1/2		1	1/4-3/8	Fall		
Currant golden		1/4		1/2	1/8-1/4		12	
Elderberry					1/4	Fall, or summer with fresh seed	12	
Honeysuckle Tatarian					1/8-1/4	Fall, or summer with fresh seed		
Jointfir green Nevada		1/2-1		1		Fall or winter		
Mountain Mahogany curlleaf true		1/2-1		1-1-1/2	1/4	Fall	12	
Rabbitbrush rubber		1/2		1/2-1				

Seeding Shrubs	Seed - Lbs./AC				Depth to Cover	Season	Minimum Precip.	Soils
	Drill		Broadcast					
	Single	Mixture	Single	Mixture	Ins.		Ins.	
Sagebrush big black		1/2-1		1-2			8-	
Saltbush fourwing	4-8	1	8-10	1	1/4	Late winter spring	7-8	Calcareous Heavy clay to sandy
Serviceberry common		1/2		1		Fall or spring	12	
Snowberry mountain common					1/4	Fall or winter	12	
Snowbrush								Non-alkaline
Sumac skunkbush smooth					1/2	Fall		
Winterfat	3-4	1/2		1	0-1/16	Late fall, winter Early spring	8-	Calcareous

Seeding Forbs	Seed - Lbs./ac				Depth to Cover	Season	Minimum Precip.	Soils
	Drill		Broadcast					
	Single	Mixture	Single	Mixture	Ins.		Ins.	
Alfalfa	6-8	1-3		1-2	1/2	Spring	9-12	Good moisture capacity
Aster Pacific		1/2		1				
Balsamroot		1/4-1/2		1/2-1			9	Well-drained fairly dry
Burnet small	30	1/2-1		3 1/2-1			11	Suited to poor droughty soils
Milkvetch chickpea	6-8	1/2-1		1-2	1/2-3/4	Spring	12	Light or heavy
Milkvetch sicklepod						Spring		
Sainfoin					1/2-3/4		12	As for alfalfa; well drained
Sweetclover	6-8	1/2-2		1	1/2-3/4	Early spring	12	Calcareous Good on disturbed soils
Sweetvetch		1/2		1/2-1			11	Light or heavy acid or alkaline

Plant-Animal Relationship*
(Animals known to utilize the plants listed)

PLANT	ANIMAL
Serviceberry (Amelanchier)	Ring-necked pheasant, crow, magpie, robin, solitaire, sage thrasher, green-tailed towhee, Lewis woodpecker, black bear, northwest chipmunk, mantled ground squirrel, mule deer, elk, mountain sheep.
Sagebrush (Artemisia)	Sage grouse, sharptailed grouse, jackrabbit, chipmunk, ground squirrel, pocket mouse, kangaroo rat, antelope, mule deer, elk, mountain sheep.
Saltbush (Atriplex)	Horned lark, black-tailed jackrabbit, antelope ground squirrel, pocket mouse, kangaroo rat, antelope, mule deer, mountain sheep.
Snowbrush (Ceanothus)	Porcupine, chipmunk, mule deer, elk.
Mountain mahogany (Cercocarpus)	Antelope, mule deer, elk, mountain sheep.
Rabbitbrush (Chrysothamnus)	Jackrabbit, antelope, mule deer, elk, mountain sheep.
Cliffrose (Cowania)	Mule deer.
Jointfir (Ephedra)	Cottontail rabbit, mule deer, mountain sheep.
Juniper (Juniperus)	Pinyon jay, western chipmunk, antelope ground squirrel, pocket mouse, mule deer.
Chokecherry (Prunus)	Blue grouse, sharptailed grouse, ring-necked pheasant, magpie, black bear, cottontail rabbit, least chipmunk, mule deer, elk, moose, mountain sheep.

*Selected from Martin, Zim and Nelson, 1951.

PLANT	ANIMAL
Bitterbrush (Purshia)	Least chipmunk, mantled ground squirrel, antelope, mule deer, elk.
Sumac (Rhus)	Magpie, robin, Townsend solitaire, western chipmunk.
Currant (Ribes)	Blue grouse, magpie, robin, Townsend solitaire, sage thrasher, Lewis woodpecker, least chipmunk, mantled ground squirrel.
Wild rose (Rosa)	Blue grouse, ring-necked pheasant, Townsend solitaire.
Willow (Salix)	Blue grouse, sharptailed grouse, beaver, mule deer, elk, moose.
Elderberry (Sambucus)	Mountain bluebird, magpie, vireo, Lewis woodpecker, elk.
Snowberry (Symphoricarpos)	Ruffed grouse, ring-necked pheasant, magpie, mule deer, elk.
Sweetclover (Melilotus)	Sharp-tailed grouse, Hungarian partridge, ring-necked pheasant, valley quail, gambel quail, rabbits, ground squirrels, antelope, deer.
Milkvetch (Astragalus)	Valley quail, gambel quail, marmot, pocket mouse, kangaroo rat, antelope.

Wildlife Habitat Requirements

Pronghorn Antelope

Present habitat usually is semi-desert bunch grass and low sagebrush.

Home range. Their daily range covers only a few square miles, however antelope do not thrive when restricted. Movements apparently are most affected by storms, forage supplies and availability of water. Migrations may be extensive; however when climate and food permit, antelope seasonal movements may be local and irregular.

Fences. Approximately 32 inches was the maximum height which most adults readily crossed. They can pass under wires spaced at least 16 inches above the ground.

Cover is not a factor for adults except during winter snowstorms and high winds when antelope may seek shelter in brushy draws or in dense stands of brush. Low shrubs 9-18 inches high provide the best kidding grounds. Alfalfa or grain fields may be utilized throughout since visibility rather than escape cover is required. The great majority of antelope observed in the sagebrush-grassland type in Central Montana was in sagebrush density of between 6 and 20 plants per 100 feet of line transect (5-24% canopy cover).

Food. Approximately 2 pounds (1.5-2.5) of oven-dried forage is required per adult animal-day. Yearlong the diet consists principally of browse. Forbs are extensively used when green. Grasses are seldom important. Alfalfa fields are particularly attractive in late summer. Grain crops are utilized in some areas. In Wyoming, Douglas rabbitbrush and big sagebrush were the most important species yearlong. Winterfat and shadscale were preferred in winter. Species utilized in proportions greater than their occurrence included: big sagebrush, fringed sagebrush, longleaf sagebrush, three-leafed milkvetch, alfalfa and sweetclover. Low sagebrush is important year long. Silver sagebrush and black sagebrush are utilized most of the year. Various junipers may be important forage summer through winter. Saltbush is eaten in spring; bitterbrush during summer. Additional forbs especially noted as important when green include species of Sphaeralcea, Eriogonum, Salsola, Lomatium, Euphorbia, Solanum, Phlox, Aster, Tragopogon, Balsamorhiza and Artemisia. Fringed sagebrush and prickly pear were utilized in winter.

Water. Antelope apparently can exist on succulent vegetation when it is available; however they drink daily if water is available. They may leave ranges when water is unavailable.

Competition. Studies show little competition between antelope and cattle. Competition with sheep may be significant on dual use winter ranges.

Odocoileus hemionus

Mule Deer

Habitat. The most productive ranges are those where man's activities have changed the vegetation to lower successional stages. Deer are widely distributed over desert shrub, pinyon-juniper and other woodlands including prairie stream bottoms, and conifer forests. An important example is the Artemisia-Agropyron association bordering or interspersed with open timbered types. In northeastern Nevada the most important winter range types included bitterbrush, mountain mahogany, snowberry or serviceberry species. Stands of pure big sagebrush or low sagebrush are rated low in deer use. Deer utilize crested wheatgrass seedings at critical times before most native grasses begin growth.

Home Range. Deer have a strong instinct to return to the same seasonal ranges each year. Seasonal movements vary in summer with the stage of growth of forage plants. During winter local deer numbers may be determined by availability of food, snow depth and condition, temperature, wind, and the amount of protective cover. The home range of bucks exceeds that of does by about fifty percent. The activity radius of males in central Utah is approximately 500 yards. In Montana home ranges of does were about one-half square mile. In northeastern Nevada deer movements during summer did not exceed one square mile. Movements on winter ranges are more restricted. Snow over 18 inches deep (less if crusted) essentially precludes use of the range by deer.

Migration. Deer usually move only as far as forced to by snow. In southeastern Idaho, a tagging study indicated the average migration distance was approximately 9 miles. The general fall movements start with the first fairly severe general snow storm. The upward drift in spring may be gradual and correlated with availability of green feed.

Cover. Shrub and tree cover is utilized for hiding, escape and protection from severe storms. Protective cover adjacent to adequate forage is a critical factor in the survival of deer in severe winters. It is unusual to find deer much more than 400 yards from cover.

Food. This is usually the weakest point in the food-water-cover triangle. Food is the one habitat factor that deer themselves deplete. The food quantity requirement for deer is about 2.4 to 2.8 or 3 lbs. air-dry/day/cwt., or from 5 to 7 lbs. of green browse. Crude protein content, a good index of a plant's food value, should be at least 7 percent for animal maintenance. About twice this level is needed for optimum growth.

Animals on an inadequate protein diet are less able to digest low quality forage. Phosphorus may be deficient in forage during winter and could adversely affect fawn production. Minimum phosphorus levels are about 0.16 and 0.25 percent. The desired Ca:P ratio is not wider than 2:1. A poor winter range will not provide enough forage to supply needed energy, or enough protein and phosphorus for the animal to make efficient use of the available energy.

Deer prefer grass when it first greens up. They turn to forbs as they appear. Utilization of herbaceous species decreases as the growing season progresses. Use of developing new shrub growth gradually increases. In general, this utilization fluctuates with the nutrient value of the forage.

In Utah, forbs important early in the season were: mules ear, alfalfa, storksbill, sweetclover and locoweed; in summer: mules ear, dogbane, geranium, dandelion, aster, Chinese lettuce, skunkflower and black medic. Browse utilized during the summer included willow, serviceberry, snowbrush, curlleaf mahogany, and cliffrose. Not eaten in summer were rabbitbrushes, sagebrush, juniper, buffaloberry, alder and ocean spray. In winter captive deer were fed a variety of browse but the average rate of consumption of big sagebrush never exceeded one pound per day. The quantity of sagebrush eaten increased as the winter progressed. Cercocarpus, Cowania and Purshia were preferred. (Smith 1950; 1953)

In Montana, deer rumen samples showed two-thirds to three-fourths of the fall and winter diet was shrubs. Major items were sagebrush (25 percent of the total diet in winter), bitterbrush, snowberry and Rocky Mountain juniper. Forbs comprised 77 percent of the diet in summer. The principal forb species in summer samples were: Tragopogon dubius, Balsamorhiza sagittata, Aster modestus, Taraxacum officinale, and Lupinus argentea. Grass utilization was minor except during spring green-up. Spring diet was: Forbs 40, grass 37 and browse 24 percent. (Wilkins, 1957)

In Owyhee Co., Idaho, 123 deer stomach samples were collected representing all months over a 3-year period. Juniper and Artemisias were the dominant species and are still invading with range depletion. Both summer and winter deer ranges were judged to be in deteriorated condition. As shown below, summer forage use by deer corresponds fairly close with availability; winter use was comparatively low for grass and high for shrubs. (Tables 1 and 2).

Table 1. Percentage plant composition and utilization by deer on an Owyhee Co., Idaho deer range. (Trout and Thiessen 1968)

	Composition Range		Utilization Range	
	Summer	Winter	Summer	Winter
Grass	9	29	7	5
Forb	8	7	9	5
Shrub	81	63	77	86

Table 2. Principal species identified in 123 deer stomachs, by months. Owyhee Co., Idaho. (Trout and Thiessen 1968)

Species	Percent Volume											
	J	F	M	A	M	J	J	A	S	O	N	D
Juoc	21	38	17	7	7						7	28
Cele						6			5	5	12	24
Artr	33	13	5	5						11	7	9
Arar		11	5									
Putr	15	35					13	22		7	19	
Prvi						9	6	8	12	6		
Prem							6	9	18			
Ceve						8	37	15	14	5		11
Syva						22	18	5	12	8		
Potre								5	5	5	21	
GRASS	7		64	75	57	15		5		11	8	7

The most important forbs were Balsamorhiza, Eriogonum, Agoseris and Phlox species.

A BLM supported study in Elko Co., Nevada, included examination of 64 deer stomach samples. The principal species identified, in percent by dry weight, are listed below. (Items shown have frequency values of at least 20%). The winter of 1968-69 was long and severe; the winter of 1969-70 was mild and open. (Compare the March diet in the two years.) The average diet for the two-year period consisted of 79% browse, 12% forbs, and 3% grass. (Table 3)

Table 3. Principal species identified in 64 deer stomachs, by months. Elko Co., Nev. (Delmas 1971)

Percent by Volume

Date	6/68	7/68	9/68	12/68	3/69	5/69	7/69	9/69	12/69	3/70
No. Deer	3	4	5	6	11	6	6	2	10	11
Species										
Amal	3	36					16	29		
Arno					8					
Arsp				8						18
Artr				55	12	25			46	28
Cele				15	11	4			28	28
Ceve	11					5	15			
Juos				5	55				4	6
Pimo					10					
Potre								7		
Potri			6							
Prvi	48	5	21				30	5		
Putr	4	23	52	7			9	33	10	
Riau		5								
Rowo								14		
Basa			5							
Crac						17				
Gesp		8								
Losp						5				
Lusp							5			
Pesp						8				
Urdi			6							
Wyam	11									
Gram						9				17
Browse	66.9	73.7	85.2	94.3	98.4	38.1	72.2	91.3	89.8	80.3
Forbs	12.1	15.5	12.4	4.3	.6	49.1	20.0	2.1	5.0	1.8
Grass	--	.1	.4	.1	.1	8.9	.6	.3	3.4	16.5

An Idaho Fish and Game study south of Jerome analyzed 31 deer stomach samples. Big sagebrush was by far the most important browse and amounted to 44% in winter samples. Eighteen samples collected in October averaged 65% woody species (including 25% quaking aspen), about 30% forbs and 3% grass.

Observations on the Pocatello game refuge indicated that mountain mahogany and bitterbrush were first choice winter browse plants. Big sagebrush and Utah juniper furnished the bulk of deer food in late winter.

In eastern Montana, Mackie (1970) observed forage utilization by deer. Sweetclover was the most important species during summer. Rubber rabbitbrush, used only after flowering, may have been the most important plant in October and November. In midwinter and during snow cover, big sagebrush, rubber rabbitbrush and Rocky Mountain juniper were most utilized. Forbs were taken when available, including yellow sweetclover, common salsify, fringed sage and phlox. In March, big sagebrush, Sandberg bluegrass, and juniper were most utilized. Bluegrass was heavily used in April and early May and forb use predominated in May. In wet years, there was more use of forbs (fall use varied from trace to 54 percent), fall use of grass and winter use of rabbitbrush.

Water. Deer have a water requirement similar to other ruminants. On Utah mountain ranges, water had little effect on deer distribution when green feed was available. When forage is dry, as in autumn, deer may trail to water and tend to concentrate there (Julander, 1966). The distances deer will range from water depend upon several obvious factors. In arid areas water may be the limiting factor. On southern deserts deer will normally go about one to one and a half miles (Hanson and McCulloch, 1955). On the Missouri River breaks of Montana, range use by deer decreased sharply when more than one mile from water; however, water was not considered to be a significant factor in determining deer distribution (Mackie, 1970).

Competition. Deer sometimes compete with bighorn sheep for forage, especially for forbs and green grasses. Elk and deer may overlap use in spring and early summer for green grass, forbs and some deciduous species, as chokecherry (Mackie, 1970). Livestock, particularly sheep, and deer seriously compete under certain conditions. Both compete for forbs and for early spring and fall growth of grasses. Bitterbrush use after June can greatly reduce the amount available for deer in winter (Jensen et al, 1971). Competition with cattle is most likely to occur on over-stocked ranges, especially in open forest types in summer and fall. In northeastern Oregon (Starkey) deer use of grasslands increased as the rate of cattle stocking increased. Deer apparently preferred deferred-rotation ranges somewhat more than season-long ranges. Competitive use of cattle forage by big game was small,

but the use of forage by cattle important to big game was great (Skovlin et al, 1968). The key areas of big game winter range and livestock spring range are often one and the same. Cattle and deer can occupy the same range in relative harmony if both are managed to apply no more than moderate pressure on the key forage species present on their key areas (Dasmann, 1971).

Alectoris graeca

Chukar Partridge

Habitat. This partridge was imported from the Himalayas, India and the Middle East where its many subspecies occupied a wide variety of habitat. The barren, steep, rocky sagebrush rangelands with river canyons, talus slopes and rimrocks are preferred habitat in this country. In these areas of low rainfall, the chukar usually is near available water; however, it is not often found on agricultural lands. The open, unimpeded view and abundant food supply of extensive cheatgrass ranges makes them especially attractive.

Home Range. The chukar normally travels over a mile radius in the course of a day. They usually run in preference to flying, but when flushed may fly and soar for a half mile before landing, although 50-400 yards is more common. Heavy snow may require seasonal movements. Marked birds have been known to move up to 21 miles in ten days in October, 17 to 20 miles in three months, and 33 miles in over two years (Christensen 1970).

Cover. When disturbed the chukars first reaction is to run uphill. Birds may run right by dense cover which quail would use to escape danger. They generally do not seek heavy vegetation for roosting, but roost on the ground under a bush or tree or in rocky outcrops. Nests are located under a shrub, clump of grass or rock overhang, often on slopes, and always well hidden from overhead view.

Food. In Nevada, cheatgrass as seeds or leaves is used every month of the year. Chukars depend heavily on exotic annual forbs. Green feed is required in spring and is readily taken whenever available. Grass and weed seeds, green leaves and stems, waste grains and wild fruits are the main diet. A variety of insects, as ants, beetles and grasshoppers, is taken in spring and summer and they are the principal diet of chicks during their first few weeks. Most feeding activity occurs in mid-morning and through the afternoon. Christensen (1970) in Nevada analyzed crop contents and found food items were as follows: November through March, seeds and green leaves of cheatgrass and filaree (availability of green grass during this period may limit chukar's habitat); April-May, fiddleneck leaves and buds, gilia and onion seeds, and insects; June through October, seeds of cheatgrass, rough fiddleneck and red-stem filaree, and grasshoppers when available. Other studies confirm the importance of cheatgrass, filaree, fiddleneck, dandelion, Russian thistle, alfalfa and various grains.

Weaver and Haskell (1967) found that chukars lost weight on a free-access diet of medusahead seeds which were largely undigested, whereas cheatgrass seeds were completely digested.

Water. Chukars tend to be near water during most of the day in hot weather. Their summer distribution seems to be closely related to availability of water and it is probably the controlling factor in chukar abundance in good habitat (Christensen 1970). Nests are usually within one mile and often less than one-half mile of water. Broods are usually raised near water. Chukars utilize any water and respond well to water developments.

Competition. Christensen (1970) knew of no instance where there is serious competition between the chukar and a native game species. Chukars are found on the same range with the mourning dove, sage grouse, California quail, mountain quail, and Gambel's quail.

Fire. According to Christensen (1970), when cheatgrass fires occur after birds are capable of strong flight it seems doubtful that any serious loss is sustained. Chukars have been observed to return to a burned area almost immediately following the fire.

Centrocercus urophasianus

Sage Grouse

Habitat. Native to western sagebrush ranges, this grouse is closely associated with various Artemisia species. At times it may temporarily occupy adjacent farm lands, river bottoms, or other shrub types. Strutting grounds are open sites of low, sparse vegetation. Broods utilize meadows in summer. Flocks may winter on low sagebrush (A. arbuscula) flats.

Home Ranges. Sage grouse require large areas in their annual cycle of movements. In some areas they make long seasonal movements; the round trip in Idaho may be 50 to 100 miles. They move altitudinally with the seasons as required by winter snow depths and by the gradual drying-out of vegetation as summer progresses, both of which limit food availability. The summer movement may be to higher or lower elevations. Birds move to breeding grounds in February or March. Strutting grounds may influence the location of nesting habitat. Most nests are within two miles of strutting grounds but they may be as far as 12 to 20 miles away and usually at elevations between the summer and winter ranges (Klebenow 1972).

Cover. Sage grouse have specialized cover requirements. Shrub cover, normally species of Artemisia, is utilized year-round, but vast, unbroken stands of high, dense brush lacking a good understory of forbs are largely unoccupied. Klebenow (1972) studying in southwestern Idaho reported that no broods were seen in three summers of sampling large tracts of dense sagebrush. Cover is most significant for nesting. Nests are usually under a sagebrush plant. Shrub density can be too light (less then 10 percent) or too heavy (over 25 percent); 15 to 20 percent is considered optimum (Klebenow 1972). At Dubois, 91 percent of nests were under threetip sagebrush averaging approximately one and one-half feet in height. Birds required at least 7 inches of clearance to nest under a shrub. Big sagebrush and bitterbrush also provided nest cover. Presence of grass and forbs in the understory is a favorable factor for both nesting and brood rearing. Young broods occupied big sagebrush sites of less than average shrub density (less than 30 percent ground cover). Brood movement followed the pattern of food plant development - succulence of favored foods being the key factor. Broods over 6 to 8 weeks of age often utilized wet meadows, alfalfa or haylands, feeding mostly on weeds. Non-nesting hens and males were in flocks during the nesting season, feeding in open areas, including burns, and roosting in dense sagebrush, often A. arbuscula. Roosting cover usually is where sagebrush is low. Tall sagebrush is used for escape cover. (Klebenow 1969, 1972).

Food. Insects provide up to 60 percent of the diet of chicks, the percent gradually decreasing as summer progresses. Succulent forbs comprise most of the diet during their growing season for both juveniles and adults. Insects such as ants, grasshoppers and beetles are taken in smaller quantity. Use of sagebrush for food begins when forbs dry up or are frost-killed, it continues through the winter and may amount to 75 percent of the diet. Black sagebrush (A. nova) was preferred in southeast Idaho. Most preferred forbs were: common dandelion (especially blooms), common salsify (especially buds), prickly lettuce, western yarrow, tapertip hawksbeard, timber poison-vetch and sego lily. (Klebenow 1969, 1972) Alfalfa and yellow sweetclover are sometimes taken.

Water. Nesting sites are close to water-usually less than one mile. Water sources include seeps, springs, lakes, troughs and irrigation facilities. Serious loss of habitat may occur when accustomed sources are cut off in the dry season. Drinking water is desirable and generally believed to be necessary for broods on summer range; however, Klebenow (1969) at Dubois reported that the broods evidently subsisted on green vegetation and moisture coming from rain or dew. By late August, however, birds had gathered near permanent water where green vegetation remained and they were observed drinking water.

Sagebrush Spraying. The possibility of conflict is great. Klebenow (1972) found that birds avoided sprayed blocks on spring and winter ranges. In Idaho, no nesting occurred on sprayed areas; this effect remained 5 years or more. Broods used some sprayed areas 3 to 5 years after treatment. Depending on the individual situation, some control of high, dense brush with little understory would improve it for sage grouse. Irregular islands should be left untreated in block projects. Habitat satisfactory for nesting and raising broods and wintering ranges should be excluded from spray treatment.

Fire. Large hot fires or repeated burning are undesirable. In Idaho, extensive burning has limited cover in some areas. There is no advantage to birds in burning winter range. Controlled fire could create the required diverse habitat pattern for nesting, provide openings for strutting, and increase forb yields.

Lophortyx californicus

California Quail

Habitat. Originally inhabiting eastern California and adjacent Nevada and Oregon, this quail has been introduced into Idaho, Utah and other western states. Coveys are commonly found near agricultural lands but they also occupy brushy foothills and valleys far removed from cropland. A good interspersion of vegetation types is especially desirable for these short-ranging birds.

Home Range. The California or Valley quail is non-migratory. The territory of a covey is usually less than one-quarter mile in radius. In California a covey may spend the winter on 40 acres.

Cover. Brush is essential to quail for escape cover and shelter. They roost in trees or shrubs--junipers are often favored. Nests are on the ground in weeds and grass or under a bush. Valley quail feeding on the ground seldom venture more than a few yards from brushy cover.

Food. Green feed is the principal diet in spring. It largely consists of seeds at other seasons; these include: wheat, barley, oats, alfalfa, sweetclover, burclover, ryegrass, lupine, filaree, fiddleneck and turkey mullein. Berries and small fruits are eaten in season. Adults eat few insects, but take some ants, beetles and grasshoppers.

Water. Normally quail drink at least once a day in warm weather. Water is often the limiting factor on quail numbers and the birds will not thrive on a poorly watered area. Succulent green feed or dew may substitute for drinking water at times. Nests are usually within a few hundred yards of water. Young birds need water within 24 hours of hatching (Mallette 1969).

Pedioecetes phasianellus

Sharp-tailed Grouse

Habitat. Native to the plains grasslands. Elimination of grass will eliminate the grouse. Optimum vegetation cover is about two-thirds grass interspersed with scattered thickets of brush and small trees. Ravines and bluffs supporting deciduous trees, and areas adjacent to streams and lakes are utilized. Head-high sagebrush is of little value. Range held in subclimax condition by grazing or fire may provide good habitat. Broods are sometimes reared in alfalfa fields.

Home Range. Sharp-tails may travel 2 or 3 miles in one flight. Banding returns indicate seasonal movements of up to 25 miles.

Cover. These grouse find shelter in grass, brushy thickets and open woods. They will dig into snow for winter shelter. Flocks sometimes perch in deciduous trees in late fall and winter. A major limiting factor is availability of suitable tall grass for nesting. Range with a good residue of previous year's vegetation is good; overgrazed range is worthless for nesting. Nests are located in the open near a shrub or clump of grass.

Food. Winter food is a critical factor. Green grasses, grains or forbs are eaten at all seasons. Foliage, buds, fruits and seeds are taken. Plant species include sunflower, wyethia, dandelion, white clover, sweet-clover, goatsbeard, knotweed, lettuce, alfalfa, fruits of rose and buffaloberry, and in winter the buds of willow, maple, chokecherry and sagebrush among others. Waste grain is a valuable winter food item if not covered by snow. Some insects, especially grasshoppers, are taken from spring through fall.

Water. Apparently water is not a factor in the distribution of the sharp-tail. Dew and succulent vegetation seem to meet their needs.

Competition. Livestock overgrazing produces unsuitable habitat.

Fire. Burned or sprayed areas in sagebrush, producing grasses and forbs, may be heavily utilized in summer for brood rearing.

Perdix perdix

Gray Partridge

Habitat. The "Hun" has been imported from Eurasia. A ground-dwelling bird, it inhabits grassland and cultivated lands. It is found in bunchgrass and sagebrush foothills adjacent to grainfields and other farmlands. It occasionally occupies both desert and open forest lands.

Home Range. Coveys range over a limited area--perhaps only one section in a lifetime.

Cover. Stubble fields, high grass and brush areas provide cover at any season. Nests are located in grass or weeds, hay fields, roadside, or edges of wetlands.

Food. Huns feed principally on waste grain, and weed seeds. They take green vegetation in season; often feed in stubble fields in winter. Berries and other fruits usually are taken after they fall to the ground. Adults normally eat only a small amount of animal food, however, when grasshoppers are plentiful Huns will feed extensively on them. Major food items listed by Martin, Zim and Nelson (1951) for birds in the Northwest are: wheat barley, oats, knotweed, bromegrass, tarweed, alfalfa and clover. Other listed items are: fiddleneck, sunflower, dandelion, buckwheat and ragweed.

Water. Drinking water generally is available in the farmland habitat occupied by the Hun.

Detrimental Factors. Fall tillage of stubble fields reduces available winter cover and feeding grounds. Early season mowing of hay is a major cause of nest destruction.

Phasianus colchicus

Ring-necked Pheasant

Habitat. The pheasant was introduced from China and is now naturalized from coast to coast principally on diversified agricultural land. In the arid West they are closely dependent upon irrigated croplands. They are practically restricted to areas of light or moderate snowfall. The intermingled, uncultivated lands such as foothills, rock outcrops, pot-holes, and river bottoms support much of the cover utilized during the entire year.

Home Range. Individual pheasants cover a relatively small area. In prairie country they seldom exceed a square mile seasonally and 5 or 6 sections during a year. In California on suitable habitat a pheasant's life-time movement may not exceed one-half mile, and cocks claim territory of around 3 to 13 acres. (Mallette 1969).

Cover. The quality of available cover may determine the pheasant population in an area. Winter survival requires rank growth such as cattails and other heavy marsh growth, brushy stream bottoms, and over-grown weed patches generally regarded as waste areas. Cover is the important factor in nest location. Nests, usually made of grass, are placed in all types of cover: grain and alfalfa fields, pastures, ditch banks, roadsides and elsewhere. To be successful nests must be free from disturbance for five weeks in the spring. Mowing of hayfields is the greatest single nesting loss. Ditch banks, fencerows and similar strips of cover furnish important escape lanes and resting sites.

Food. Pheasants customarily feed from the ground surface or from low vegetation. Weed seeds, small grains, and fruits of woody plants comprise the bulk of their diet. Mallette (1969) found that waste grain amounted to more than half the diet, and weed seeds totalled thirty percent. Chick diet was entirely insects but gradually changed until at 12 weeks of age it was similar to the adults. Specific food items include wheat, barley, corn, alfalfa, sweetclover, sunflower, dandelion, knotweed, Russian thistle, wild lettuce, mallow, sugar beets, and fruits of rose, hawthorn, oak, sumac, dogwood, wild currant, snowberry and wild cherry. (Martin, Zim and Nelson 1951); Rasmussen and McKean 1945). During a severe winter in northern Utah, crop analysis showed the pheasant diet to consist of seeds and fruits of rose, Russian olive, redroot, ragweed, dock, knot-weed, sunflower, teasel, and waste grain; also some leaves of grasses, alfalfa, and dandelion were present. (Rasmussen and McKean 1945).

Water. Pheasants inhabit well-watered lands and are not commonly found far from them.

Detrimental Factors. In the Intermountain-West, Rasmussen and McKean (1945) listed the following practices as most detrimental to pheasant habitat: heavy late season grazing of winter cover, nest losses due to early hay mowing, flood irrigation of cultivated crops, fall plowing, burning of waste areas, and burning ditch and canal banks.

Zenaidura macroura

Mourning Dove

Habitat. Native throughout most of the United States, the dove has adapted to changing habitat and lives on farms and in towns as well as in most shrub types, open woods and orchards, prairies and deserts. Doves prefer open country. Weed patches and cropland have increased dove habitat.

Home Range. The mourning dove is migratory. It begins moving southward early (September) and returns in May.

Cover. Doves usually do not rely on escape cover, but on flight to avoid enemies. Nests may be in trees, shrubs or on the ground. In sagebrush and other shrub types, doves usually nest on the ground. Roosting may be in trees but in our area it is generally in open fields or grazed pastures.

Food. Almost the entire diet consists of seeds found on the ground. Few seeds are too small. They take early maturing grass and weed seeds in summer, waste grain and weed seeds after crops are harvested, and late maturing or persistent weed seeds in the early fall. Fiddleneck is an important food plant on burns and other disturbed areas.

Water. Doves can range long distances from water (at least 4-6 miles), however, they require water daily. They usually drink following feeding periods in the morning and evening - especially just before dark. Water is an important limiting factor. Birds use practically any source of water but prefer shallow edges of ponds and streams in the open. Doves will use access ramps placed in stock-water troughs.

Appendix 8
(F)

Selected Game Bird Nesting Data

Species	Nesting dates	No. of eggs	Incubation days	Hatching dates
California quail	Apr-June	10 - 17	21 - 22	Late May to July
Chukar	Apr-May	8 - 15	22 - 24	May June
Gray partridge	May-June	10 - 22	23 - 24	June
Mourning dove*	May-Sept.	2	14 - 15	June (peak)
Ring-necked pheasant	May	6 - 14	23 - 24	Early June
Sage grouse	Apr-May	6 - 12	22 - 24	May
Sharp-tailed grouse	May	7 - 13	21	Late May early June

* Normally produces several clutches per year.

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